Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH

LIBRARY
COLLEGE OF ENGINEERING
DUKE UNIVERSITY

MARCH 8, 1965

VOLUME 3 • NUMBER 5

N65-14476—N65-15425

DOCUMENTS DEPT.

MAR 1 6 1965

Duke University Library

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Purchase of *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

Semimonthly issues. Annual subscription rate: $33.00, domestic; $42.00, foreign. Price per single copy: $2.25, domestic; 25¢ extra for foreign mailing.

Cumulative index issues. Annual subscription rate: $30.00, domestic; $35.00, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

Published by:
United States Government
National Aeronautics and Space Administration
Scientific and Technical Information Division

Scientific and Technical Aerospace Reports, Volume 3, is prepared by the Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget January 9, 1965

Introduction

Scientific and Technical Aerospace Reports (STAR) is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

Major areas covered in *STAR* are:

- Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

The first section of *STAR*, arranged by subject categories, contains informative abstracts and complete bibliographic citations. A second section consists of five indexes: subject, corporate source, author, report/accession number, and accession/report number. Cumulated indexes are published quarterly for the first three quarters, with an annual index cumulating all four quarters. Each cumulated index issue also contains a contract number index.

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

NASA documents (identified with an asterisk), as well as *STAR* itself, are available without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.
2. Other U.S. Government agencies and their contractors.
3. Libraries that maintain collections of NASA documents for public reference.
4. Other organizations having a need for NASA documents in work related to the aerospace program.
5. Foreign organizations that exchange publications with NASA, or that maintain collections of NASA documents for public use.

NASA documents identified with the symbol # have been placed on microfiche and are available in that form without charge to the organizations listed above.

AGARD reports that are not commercially available will also be provided by NASA to the organizations listed above.

Other non-NASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.

How to Request Listed Documents

If you are registered with NASA, send a completed *Document Request* (Facility Form 492) to:

Scientific and Technical Information Facility
P.O. Box 5700
Bethesda, Maryland, 20014

If you are eligible to receive documents without charge (see previous page) but are not registered with NASA, request *Registration Form—Technical Publications* (NASA Form 439) from:

Scientific and Technical Information Facility
Attention: NASA Representative
P.O. Box 5700
Bethesda, Maryland, 20014

How the Public May Obtain Listed Documents

For reference purposes, NASA documents listed in *STAR* may be consulted at one of the organizations listed on the inside back cover. Commercial publications listed in *STAR* may usually be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents listed in *STAR* from either of two sales agencies, as specifically identified in the abstract section:

- Clearinghouse for Federal Scientific and Technical Information (OTS), Port Royal Road, Springfield, Virginia 22151
- Superintendent of Documents (GPO), U.S. Government Printing Office, Washington, D.C., 20402

NASA documents available from the Clearinghouse for Federal Scientific and Technical Information are sold in hard-copy and microfiche form. If printed hard-copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" for full-size or facsimile; "MF" for microfiche. The price is also given.

The public may request non-NASA documents by writing to the source, or other information systems. Identification other than the NASA accession number (N65-12345) should always be provided when requesting such a document from its source.

Abstracts of Journal Articles

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses identical subject categories with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017.

Scientific and Technical Information Division
National Aeronautics and Space Administration

Table of Contents

Volume 3 Number 5 / March 8, 1965

Abstracts in the journal are grouped under the following categories: PAGE

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. 703

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 704

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. 705

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology. 707

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences. 715

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. 718

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. 726

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. 735

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 738

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 745

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. . . . 749

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 752

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 758

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 765

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. 774

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 780

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 780

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 786

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 787

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 791

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 796

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 797

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **800**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **804**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **811**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **818**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. . . . . **No Abstracts**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **823**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **825**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **829**

31 SPACE VEHICLES
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **834**

32 STRUCTURAL MECHANICS
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **837**

33 THERMODYNAMICS AND COMBUSTION
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **841**

34 GENERAL
Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **850**

SUBJECT INDEX I–1

CORPORATE SOURCE INDEX I-61

PERSONAL AUTHOR INDEX I-81

REPORT/ACCESSION NUMBER INDEX I-115

ACCESSION/REPORT NUMBER INDEX I-125

VOLUME 3 NUMBER 5

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

March 8, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-14538*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center

A REPORT BIBLIOGRAPHY FOR THE TRISONIC AERODYNAMICS OF CONE-CYLINDER-FLARE-CYLINDER TYPE BODIES

Roger L. Hamner 19 Feb. 1964 30 p refs

(Contract NAS8-5327)

(NASA-CR-60057; LMSC/HREC-A033441; TM-54/01-45)

OTS: HC $2.00/MF $0.50

N65-14661# ARO, Inc., Arnold Air Force Station, Tenn.

INVESTIGATION OF STING SUPPORT INTERFERENCE EFFECTS ON THE DYNAMIC AND STATIC STABILITY CHARACTERISTICS OF A 10-DEG CONE AT MACH NUMBERS 2.5, 3.0, AND 4.0

B. L. Uselton Arnold Eng. Develop. Center, Nov. 1964 23 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-226; AD-450660)

A free oscillation, cross-flexure pivot balance system was used. Data were obtained at Mach numbers of 2.5, 3.0, and 4.0 at Reynolds numbers ranging from 0.45×10^6 to 10.2×10^6. Selected test results are presented, and comparisons are made with first- and second-order potential flow theory and conical flow theory. Author

N65-14813# Sandia Corp., ALbuquerque, N. Mex.

PRESSURE DISTRIBUTIONS ON SPHERE CONES

D. M. Ellett Jan. 1964 55p refs

(SC-RR-64-1796)

Data, obtained from Russian sources, on the distribution of pressure on sphere cones are presented. The results of the Russian calculations were transformed into units used widely in the United States, and tabulated and plotted, both (1) as a pressure ratio of the local static cone pressure to the stagnation point pressure versus the normalized surface distance and (2) as a coefficient of pressure versus the normalized surface distance. The pressure distributions are calculated for cone angles (the angle between the surface of the cone and its axis of symmetry) of 0°, 5°, 10°, 20°, 30°, and 40° and for Mach numbers of 3, 4, 6, 10, and infinity. P.V.E.

N65-14837# Grumman Aircraft Corp., Bethpage, N.Y. Research Dept.

PRESSURE MEASUREMENTS FOR MACH 8 FLOWS OVER EXPANSION CORNERS AND RAMPS ON AN INTERNALLY COOLED MODEL. PART II: FLOWS OVER A FLAT PLATE WITH AND WITHOUT A PARTIAL SPAN RAMP. PART OF AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS

Louis Kaufmann, II Wright-Patterson AFB, Ohio. Res. and Tech. Div., Oct. 1964 184 p refs

(Contract AF 33(616)-8130)

(RTD-TDR-63-4044, Pt. II; AD-609458)

Pressure distributions were obtained for Mach 8 flows over a sharp 40° expansion corner and ahead of ramps on an internally cooled model. Full and partial span ramps, having wedge angles up to 30° were tested at model angles of attack from −45° to +10° for Reynolds numbers ranging from 1.1 to 3.3 million. The model wall temperature was maintained at fairly constant levels ranging from 450° to 1150° Rankine. Author

N65-14838# General Electric Co., Cincinnati, Ohio. Flight Propulsion Div.

TANDEM CASCADE THRUST VECTORING RESEARCH PROGRAM

Patrick A. Cancro and John E. Yeates Ft. Eustis, Va., Army Transportation Res. Command, Nov. 1964 149 p refs

(Contract DA-44-177-AMC-73(T))

(TRECOM-TR-64-59; AD-609059)

The combination of transonic cascade tunnel testing and scale model system testing conclusively demonstrated that tandem cascade thrust vectoring can provide an efficient system for STOL or VTOL propulsion systems. The performance superiority of the flexible airfoils over the flapped and articulated airfoils is clear and dramatic up to test Mach numbers encountered in V/STOL devices. After evaluation of proper testing techniques, wind tunnel cascade testing of the flexible airfoils in a tandem cascade configuration showed satisfactory operation up to test Mach numbers of 0.5. Low-speed testing with two cascades of flexible camber blading behind a scale-model cruise fan demonstrated efficient thrust vectoring through 90° suitable for VTOL operation. Efficient thrust vectoring through 67° and 120° with a maximum of 50% of reversed thrust as required for STOL operation was demonstrated. The results from the cascade wind tunnel tests obtained at high Mach number prove that these low-speed results obtained at 0.1 Mach number are valid up to an operating Mach number of 0.5. Consequently, the application of the tandem cascade thrust vectoring system to V/STOL systems is feasible. Author

N65-15059*# Consultants and Designers, Inc., Arlington, Va.
ON THE ROTATIONAL MOTION OF A SPHERICAL SATELLITE UNDER THE ACTION OF RETARDING AERODYNAMICAL MOMENTS [O VRASHCHATEL'NOM DVIZHENII SHAROVOGO SPUTNIKA PRI DEYSTVII TORMOZYASHCHIKH AERODINAMICHESKIKH MOMENTOV]
Nam Tum Po 22 Jan. 1965 10 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 19, iss. 4, 1964 p 129–134
(Contract NAS5-3760)
(NASA-TT-F-9630; ST-CM-AD-10280) OTS: HC $1.00/MF $0.50

This paper considers the effect of aerodynamic moments on the rotational motion of a spherical satellite relative to the center of inertia. The latter coincides with the center of the sphere. This effect is great, provided the satellite has a small mass and a large radius. Author

N65-15409# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
ON THE DETERMINATION OF OPTIMUM SHAPES WITH FINITE NOSE ANGLES
P. J. Zandbergen Jul. 1964 12 p refs Submitted for Publication
(NLR-TR-G.30)

A method is presented for determining axially symmetric shapes that are optimum with respect to wave drag and which have finite nose angles. Use was made of the exact nonlinear differential equation for supersonic flow together with the shock equations. The computed results indicate that the optimum bodies with a finite nose angle have a lower drag than those with cusped noses. A number of such shapes were presented. Author

N65-15410# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE COMPUTATION BY LIGHTHILL'S METHOD OF TRANSONIC POTENTIAL FLOW AROUND A FAMILY OF QUASI-ELLIPTICAL AEROFOILS
G. Y. Nieuwland Sep. 1964 33 p
(NLR-TR-T.83)

This report contains a number of numerically worked out transonic profile flows, derived from the symmetrical incompressible flow around an ellipse by Lighthill's method. Severe computational difficulties have been overcome by a formal application of Wynn's ϵ-algorithm. A discussion on the transonic controversy is presented. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-14820 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
APPLICATION OF THE LIMIT-CYCLE SELF-ADAPTIVE CONCEPT TO THE B-58 LATERAL DIRECTIONAL STABILITY AUGMENTATION SYSTEM
Boris E. Bright and John D. Ellington (M.S. Thesis) May 1964 88 p refs
(GGC/EE/64-5; AD-604253)

The limit-cycle concept is used to design a lateral-directional control system for the B-58. Existing servos and sensors are used, and the mechanical aileron-to-rudder interconnect is maintained. An analog simulation is used to evaluate the feasibility of the concept as applied to the B-58. The design is evaluated for roll-damper failure, coordination, wing heaviness, and engine failure. The evaluation shows that the concept will usually result in a system with good lateral stability but low dutch roll damping. The low damping can cause serious pilot coupling. Some possible corrective measures are indicated. Author

N65-14854*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT-MEASURED WING SURFACE PRESSURES AND LOADS FOR THE X-15 AIRPLANE AT MACH NUMBERS FROM 1.2 TO 6.0
Jon S. Pyle Washington, NASA, Jan. 1965 45 p refs
(NASA-TN-D-2282) OTS: HC $2.00/MF $0.50

Flight-measured pressure distributions are presented for the upper and lower surfaces on the wing and wing–body juncture of the X-15 airplane at angles-of-attack from 0° to 20° and Mach numbers from 1.2 to 6.0. Aerodynamic loads derived from surface pressure measurements are presented as spanwise load distributions and total exposed wing-panel loads. The results of the investigation indicate that chordwise and spanwise centers of pressure remain fairly constant as Mach number increases. Isolated-wing theories (shock expansion and linear) generally underestimated the aerodynamic loads, with the exception of pitching moment. Linear theory (wing in presence of body) gave fair predictions of the experimental lift-curve slopes at the lower angles-of-attack. The agreement between flight measurements and wind-tunnel results was well within the accuracy of the data. Author

N65-14987# Republic Aviation Corp., Farmingdale, N.Y.
VA-3 AIR CUSHION, VEHICLE TEST PROGRAM Final Report
20 Oct. 1964 200 p refs
(Contract Nonr-4500(00))
(RAC-2612; AD-607768)

To evaluate the technical and operational feasibility of an air cushion vehicle or ground effect machine (GEM), overwater sea trials, surf tests, long-crested wave runs, and overland runs were conducted. Results showed a capability for landings and departures through surf with high breaking waves, and for maintaining headway without sustaining structural damage in 8- to 12-ft short-crested waves. Vehicle stability and ride characteristics are considered superior to those of hydrofoils and planing hull craft. Maximum normal bow accelerations in short-crested waves were recorded at 1.5 g, with a drop to below 0.6 g for approximately 80 percent of normal bow accelerations in sea state 3. Overland performance was demonstrated over obstacles, negotiable gradients, rocky areas, and marshland, with several runs over a 5-ft embankment in both directions. Turning radius was determined at 5, 10, 15, and 20 knots. Tests proved that the structural criteria were adequate, except for bow impact loads and the flexible skirt design. M.G.J.

N65-14989# Bell Aerosystems Co., Buffalo, N.Y.
STUDY OF FLEXIBLE JET EXTENSIONS FOR AIR CUSHION VEHICLES, PHASE III

J. B. Chaplin et al Oct. 1964 80 p refs
(Contract Nonr-4491(00))
(Rept.-2131-920003; AD-607771)

A trunk design was developed for a model which provided realistic test conditions for the evaluation of seven commercially available flexible trunk materials. One previously used and four new coated fabrics were model tested. The basic material in each case was nylon fabric, with a different coating for each sample. The specification developed for flexible trunk material is presented. Final performance testing was conducted in the whirling arm facility. Test results indicate that chlorosulfonated polyethylene and neoprene will probably perform well in flexible trunks and prove to be superior to the previously used urethane elastomer coating. A definite correlation between laboratory-measured shear strength and material tearing performance was shown, but poor correlation was obtained for measured abrasion resistance and actual wear performance. While no one material evaluated has adequate values for all critical values, these design and test results are adequate for the immediate future. E.P.V.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-14539*# Union Carbide Corp., Parma, Ohio. Parma Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Quarterly Report, Period Ending 30 Nov. 1964
M. L. Kronenberg [1964] 21 p refs
(Contract NAS3-6460)
(NASA-CR-54249) OTS: HC $1.00/MF $0.50

It has been observed under certain conditions that heavy discharge pulses significantly improve the performance level of fuel cells. This investigation is concerned with defining the conditions under which pulsing improves fuel cell performance. How this "pulsing effect" depends on such factors as nature of the catalyst, catalyst concentration and temperature, as well as its effect on electrode life, is also studied. Author

N65-14597*# Yardney Electric Corp., New York, N.Y.
DESIGN AND DEVELOPMENT OF A HERMETICALLY SEALED 12 AMPERE-HOUR SILVER-CADMIUM CELL IN A NONMAGNETIC METALLIC CASE Final Report
[1964] 21 p
(Contract NAS5-2155)
(NASA-CR-60026) OTS: HC $1.00/MF $0.50

Described are the design, development, and test results of hermetically sealed silver-cadmium cells built into nonmagnetic metallic containers. The final cell design was provided with an inner plastic case and an outer nonmagnetic stainless-steel housing. Special welding techniques for the manufacture of the stainless container were developed to avoid introducing magnetic properties. The cells were grouped into five batteries of 13 cells each, and were cycled under a simulated 300-mile orbital regime at temperatures of −10°, 20°, and 40° C under vacuum conditions and using a radiation heat sink. Cell failures occurred at 313 to 1350 cycles. Author

N65-14809*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Solar Energy Systems Group
BRAYTON CYCLE SOLAR COLLECTOR DESIGN STUDY Final Report, 26 Jul. 1963–10 Apr. 1964
Edward S. Kovalcik et al Mar. 1964 206 p refs
(Contract NAS3-2789)
(NASA-CR-54118; TRW-ER-5838) OTS: HC $6.00/MF $1.25

Analyses of solar concentrator performance and thermal and structural requirements are presented along with the specific design recommendation for the Brayton-cycle system. Fabrication considerations, which were limited to the stretch-forming technique, are discussed. Small specimen fabrication and inspection results are presented, as well as the results of surface error evaluations for a complete stretch-formed solar concentrator. The resulting recommended design geometry, weight, and predicted performance are presented. Author

N65-14823# Naval Research Lab., Washington, D.C. Solid State Div.
ELECTRON-BOMBARDMENT DAMAGE IN SILICON SOLAR CELLS Final Report
R. L. Statler 7 Oct. 1964 56 p refs
(NRL-6091; AD-608213) OTS: $1.50

A study has been made of the radiation damage in 11 types of silicon solar cells as a result of 1-MeV electron bombardment. Included in the study are p/n cells, n/p cells of different bulk resistivities, planar cells, and drift-field cells. A comparative analysis was made of the radiation-induced degradation in these cells as a function of short-circuit current, maximum power output, minority-carrier diffusion length, and photovoltaic spectral response. The p/n cells were found to be much more sensitive to radiation damage than any type of n/p cells in this investigation. In the n/p cells, there is a definite indication of increasing radiation resistance accompanying increasing values of bulk resistivity, up to 10 ohm-cm. The drift-field solar cells exhibit a further improvement in radiation resistance beyond that of the other types of n/p cells. Author

N65-14951*# Honeywell, Mineapolis, Minn. Aeronautical Div.
STUDY OF AN ATTITUDE CONTROL SYSTEM FOR THE ASTRONAUT MANEUVERING UNIT, VOLUME I Final Report, Dec. 1963–Jul. 1964
I. E. Drissel, R. L. Haines, R. J. Kell, N. Lovinger, and D. M. Moses 15 Jul. 1964 210 p refs */ts* Rept.-1781-FR1
(Contract NASw-841)
(NASA-CR-60166) OTS: HC $6.00/MF $1.25

Development of a suitable Attitude Control System (ACS) for Astronaut Maneuvering Units (AMU) is discussed, and developments associated with obtaining an operational system are defined. An attempt was made to provide (1) a conceptual design (with specifications and instrumentation drawings) of an ACS suitable for an AMU; (2) analyses and tradeoff considerations with details of how the conceptual design was evolved and established; and (3) a clear understanding of the problems encountered in developing a workable design. Problem solutions were recommended as a basis for future AMU program planning offering the most benefit with the least investment. A system was developed using a voice-operated controller for both attitude and translational control, three floating integrating gyros for attitude and translational sensing, a fixed pulse and pseudorate control system, and eight reaction jets. P.V.E.

N65-14952*# Honeywell, Minneapolis, Minn. Aeronautical Div.
STUDY OF AN ATTITUDE CONTROL SYSTEM FOR THE ASTRONAUT MANEUVERING UNIT, VOLUME II Final Report
W. E. Drissel, R. L. Haines, R. J. Kell, D. N. Lovinger, and D. M. Moses 15 Jul. 1964 79 p *Its* Rept.-1781-FRI, Vol. 11
(Contract NASw-841)
(NASA-CR-60165) OTS: HC $3.00/MF $0.75

Presented are specifications defining the requirements for an attitude control system (ACS) for an astronaut maneuvering unit (AMU). Also included are the requirements for a controller to be used by the astronaut in commanding translational or rotational movement. The specifications are divided into sections: (1) requirements for the unit attitude control system, (2) the specifications for the system—sensors and control electronics, (3) performance specifications for the systems control electronics, and (4) specifications for a voice controller breadboard. P.V.E.

N65-14953*# Honeywell, Minneapolis, Minn. Aeronautical Div.
STUDY OF AN ATTITUDE CONTROL SYSTEM FOR THE ASTRONAUT MANEUVERING UNIT, VOLUME III Final Report,
W. E. Drissel, R. L. Haines, R. J. Kell, D. N. Lovinger, and D. M. Moses 15 Jul. 1964 25 p *Its* Rept.-1781-FRI, Vol. III
(Contract NASw-841)
(NASA-CR-60162) OTS: HC $1.00/MF $0.50

Drawings for an attitude control system for use in an astronaut maneuvering unit comprise this report. Diagrams include the installation and circuit for the control electronics package, together with schematics of the welded module roll, pitch and yaw computers, logic and TCA, jet drivers, power supply, and jig wafer assembly. Installation drawing and schematic on the sensor package, diagrams on voice controller flow and system flow, and the parts lists are also presented. M.G.J.

N65-14978# Wisconsin U., Madison. Solar Energy Lab.
PHOTOVOLTAIC POWER SYSTEMS USING HIGH SOLAR ENERGY FLUXES Second Quarterly Progress Report, Jun. 1–Aug. 31, 1964
P. Schoffer, W. Hartman, and W. Beckman [1964] 28 p refs
(Contract DA-28-043-AMC-00005(E))
(Rept.-2; AD-453205)

A previous report showed that at high solar fluxes and normal cell temperatures, an anomalous curvature of the voltage–current relationship exists near the voltage axis. By including a "shunted diode" effect in the computer model of the cell, it was possible to fit the computed points to the experimentally observed data. Various possibilities for the reduction of the cooling system power requirements are discussed. These include (1) use of a chimney, (2) use of a turbine ventilator, and (3) use of intermittent cooling system operation with larger and thereby more efficient equipment. The breadboard solar concentrator is discussed in general terms. The use of 441 individual mirrors is proposed for the breadboard system. This one design will enable the solar flux on the cells to be varied over a wide range with uniform intensity. Author

N65-15083# Inland Testing Labs., Dayton, Ohio.
ALKALINE CELL EVALUATION AND ANALYSIS Quarterly Technical Progress Report, 15 May–15 Aug. 1964
E. A. Roeger, Jr. and P. R. Voyentzie 1 Sep. 1964 28 p
(Contract AF 33(615)-1580)
(QTPR-1; AD-447480)

The purpose of this program is to determine the actual failure mechanism of all components of alkaline storage batteries and to determine techniques and materials to prevent these premature failures, and to devise analytical methods for predicting the life of cells under any environmental condition. The program is also concerned with determining methods for gas suppression and the hermetic sealing of alkaline cells. The program was separated into five different parts: (1) Investigation of Seals, (2) Investigation of Cell Operating Variables, (3) Investigation of Memory Effects, (4) Investigation of Variable, and (5) Evaluation of New or Improved Cells. Author

N65-15101# Stanford U., Calif.
DIRECT ENERGY CONVERSION SYSTEMS Fourth Quarterly Technical Summary Report, 1 Jun.–31 Aug. 1964
Robert H. Eustis 30 Sep. 1964 101 p refs
(Contract AF(638)-1123; ARPA Order 246)
(AD-609415)

The MGD generator electrode materials problem has been greatly simplified by introducing cooling water into the electrode stems. Runs of over one-half hour duration indicate a negligible recession of the surface so that the same electrodes can be used for several runs. The influence of the Ramsauer effect on nonequilibrium electron temperatures is investigated further. The calculation of electrical conductivity by the Chapman–Enskog method was compared to the method of Frost. Very satisfactory agreement has been shown and the assumptions of Frost were given a more rigorous foundation. Diagnostic methods have been improved with the development of the spectroscopic-line-reversal technique. Temperature measurements believed accurate to $\pm 10°$ K have been made in seeded flames. An investigation of the effect of free stream turbulence on the limiting current density at the front stagnation point of a translating cylinder electrode was undertaken. An effect of the cylinder diameter and whether the electrode was cathodic or anodic were observed. Author

N65-15132# Boeing Co., Seattle, Wash.
DISCUSSION AND WEIGHT PREDICTION OF REGENERATIVE FUEL CELLS SYSTEMS, VOLUME II
J. H. Thielman [1964] 34 p refs
(D2-22311-1, Vol. II; AD-450433)

The components required in the regenerative system of a hydrogen–oxygen fuel cell, together with an electrolysis cell, are used to form a conceptual system. The total weight of the regenerative system is then plotted against orbit altitude and vehicle power requirements and compared to solar power system weights using conventional nickel–cadmium storage batteries. For orbital applications, there is little weight difference between the two. However, for lunar surface missions, regenerative fuel cells may show a significant advantage if stored energy is required during 14 days of lunar darkness. M.G.J.

N65-15205# Texas Instruments, Inc., Dallas. Energy Research Lab.
MOLTEN-CARBONATE FUEL BATTERY PROGRAM Second Quarterly Progress Report, 16 Aug.–15 Nov. 1963
J. K. Truitt and C. G. Peattie [1963] 45 p refs
(Contract DA-44-009-AMC-54(T))
(TI-08-63-163; AD-424564)

Work continued on the development of the molten-carbonate fuel cell into a practical electric power source operated on liquid hydrocarbon fuels. A number of minor changes in cell module design and operation resulted in some improvement in operability. However, a problem affecting useful life

occurred in scale-up from the small test cells. Although the formation of silver dendrites and the consequent shorting-out of cells was not a problem with the small cells, it became a real problem with the larger cells and cell modules. Work to reduce or circumvent this problem is continuing. Also, the effects of this difficulty on reliability are not great enough to preclude construction of a 100-watt demonstration unit operating with an integral liquid hydrocarbon conversion unit, and design work is being continued on such a demonstration system. R.R.D.

N65-15252*# Battelle Memorial Inst., Columbus, Ohio.
THE ALPHA-CELL DIRECT-CONVERSION GENERATOR Final Report
A. M. Plummer, W. J. Gallagher, R. G. Matthews, and J. N. Anno 30 Nov. 1964 114 p refs
(Contract NAS3-2797)
(NASA-CR-54256) OTS: HC $4.00/MF $0.75

Experiments performed on a generator in which alpha-particle kinetic energy is converted directly to electrical energy resulted in voltage buildup in the 50- to 100-kilovolt range. Microdischarging in the experimental cell was determined to be the factor preventing higher voltage buildup. The experiments also provided information on generator design, especially on the factors influencing control of secondary electrons by an electrical grid. Methods of converting the high-voltage (megavolt range) expected from improved experimental cells to lower voltage were also investigated. A converter incorporating a piezoelectric transformer was conceived and designed. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-14491# RCA Service Co., Inc., Camden, N.J.
TECHNIQUES OF PHYSIOLOGICAL MONITORING. VOLUME III: SYSTEMS
Richard W. Alnutt, Walter C. Becker, and Robert E. Barbiere, ed. Wright-Patterson AFB, Ohio. Aerospace Med. Res. Labs., Oct. 1964 152 p refs
(Contract AF 33(657)-9252)
(AMRL-TDR-62-98(III); AD-609481)

This volume is a discussion of monitoring systems. The primary concern is with viability monitoring, the use of a measurement system to obtain factual, quantitative information about the physiological responses of a subject in a stressful environment, in order to plan protective measures which will ensure the safety and functional capability of that subject in such environments. Included are a description of instrumentation required for the measurement of individual physiological parameters, a discussion of related problems in system design, including simultaneous measurement of several parameters, data transmission or telemetry, and the use of magnetic tape recording as a system adjunct. Basic guidelines of system troubleshooting and interference reduction are included. A brief survey is given of additional measurement techniques and data handling considerations which, while not state-of-the-art or standard practice, will undoubtedly affect the field of physiological monitoring in the near future. Author

N65-14526# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCES OF THE USSR. BIOLOGICAL SERIES Selected Articles
1 Oct. 1964 66 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 2, 1964 p 280–297, 306–311, 325–331)
(FTD-TT-64-534/1+2+4; AD-607121)

CONTENTS:

1. THE DYNAMICS OF BLOOD CIRCULATION PARAMETERS OF THE CEREBRAL VASCULAR SYSTEM DURING LONGITUDINAL GRAVITATIONAL LOADS Yu. Ye. Moskalenko, O. G. Gazenko, A. A. Shurubura, I. I. Kas'yan, and O. V. Graunov p 1–32 refs (See N65-14527 05-04)

2. EMOTIONAL STRESS OF COSMONAUTS DURING SPACE FLIGHTS V. I. Yazdovskiy, G. V. Altukhov, V. Ye. Belay, A. D. Yegorov, and V. Y. Kopanev p 33–42 refs (See N65-14528 05-04)

3. A SYMPOSIUM ON APPLIED MICROBIOLOGY (IN STOCKHOLM, SWEDEN) Ye. N. Mishustin and N. D. Ierusalimskiy p 43–61

N65-14527 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DYNAMICS OF BLOOD CIRCULATION PARAMETERS OF THE CEREBRAL VASCULAR SYSTEM DURING LONGITUDINAL GRAVITATIONAL LOADS
Yu. Ye. Moskalenko, O. G. Gazenko, A. A. Shurubura, I. I. Kas'yan, and O. V. Graunov *In its* News of the Acad. of Sci. of the USSR. Biol. Ser. 1 Oct. 1964 p 1–32 refs (See N65-14526 05-04)

The reactions of an organism to gravitational loads are a basic problem of space biology. One of the most sensitive systems to space flight is the cerebral blood circulation system, due to the peculiarities of its structure and the high intensity of cerebral blood flow. The general pattern of changes in the intracranial circulation system under gravitational loads and acceleration magnitudes was studied, emphasizing the dynamics of the circulation parameters of the cerebral vascular system. Under longitudinal gravitational loads, organs of the central nervous system functioned under conditions of insufficient blood supply, which caused definite compensatory reactions in the vascular system of the brain as well as reactions of an automechanical and chemical nature. R.W.H.

N65-14528 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EMOTIONAL STRESS OF COSMONAUTS DURING SPACE FLIGHTS
V. I. Yazdovskiy, G. V. Altukhov, V. Ye. Belay, A. D. Yegorov, and V. I. Kopanev *In its* News of the Acad. of Sci. of the USSR. Biol. Ser. 1 Oct. 1964 p 33–42 refs (See N65-14526 05-04)

The neuropsychological stress which arises in cosmonauts before launch, in different flight periods, and under the effect of acceleration on earth is analyzed. To determine the functional state of the organism, the pulse rate was measured. When an organism is subjected to acceleration of a different direction, substantial changes of pulse rate are observed. The degree of these changes depends directly on the magnitude and length of acceleration. When the cosmonauts were under weightlessness for an extended period of time, there was a decrease in their resistance to acceleration expressed in more significant shifts of the pulse rate. A certain dependence of these shifts on the time under weightlessness was noted. R.W.H.

N65-14598# Joint Publications Research Service, Washington, D.C.
MEDICAL AND BIOLOGICAL RESEARCH ON SPACE VEHICLES "VOSTOK" AND "VOSKHOD"
21 Dec. 1964 48 p refs Transl. into ENGLISH from 2 RUSSIAN monographs For NASA transl. see N65-14607 05-04
OTS: $2.00
(JPRS-27925; TT-64-51975) OTS: $2.00

CONTENTS:

1. MEDICAL RESEARCH CONDUCTED ON THE SPACE SHIPS "VOSTOK" AND "VOSKHOD" O. Gazenko p 1–26 (See N65-14599 05-04)

2. BIOLOGICAL RESEARCH CONDUCTED ON THE SPACESHIPS "VOSTOK" AND "VOSKHOD" V. V. Antipov p 27–40 (See N65-14600 05-04)

N65-14599 Joint Publications Research Service, Washington, D.C.
MEDICAL RESEARCH CONDUCTED ON THE SPACE SHIPS "VOSTOK" AND "VOSKHOD" [MEDITSINSKIYE ISSLEDOVANIYA NA KOSMICHESKIKH KORABLYAKH "VOSTOK" i "VOSKHOD"]
O. Gazenko *In its* Med. and Biol. Res. on Space Vehicles "Vostok" and "Voskhod" 21 Dec. 1964 p 1–26 (See N65-14598 05-04) OTS: $2.00

A brief survey of the principal results derived from medical (physiological) studies during manned flights aboard the Vostok and Voskhod spaceships is given. The aims of medical research included determining the effect of isolated and combined factors of space flight on physiological functions on the body, the efficiency and reliability of life support and life saving systems for maintaining medical control over the crew, the capacity and ability to carry out different operations in controlling the ship and methods for increasing human resistance to flight factors. Human beings given special training are able to endure the effects of all portions of an orbital flight. However, the individual reaction of the cosmonaut is an important factor and must be accorded special consideration for future training programs for the crews of spaceships. R.W.H.

N65-14600 Joint Publications Research Service, Washington, D.C.
BIOLOGICAL RESEARCH CONDUCTED ON THE SPACESHIPS "VOSTOK" AND "VOSKHOD" [BIOLOGICHESKIYE ISSLEDOVANIYA NA KOSMICHESKIKH KORABLYAKH "VOSTOK" I "VOSKHOD"]
V. V. Antipov *In its* Med. and Biol. Res. on Space Vehicles "Vostok" and "Voskhod" 21 Dec. 1964 p 27–40 (See N65-14598 05-04) OTS: $2.00

A brief survey of the main results of the biological investigations conducted during the flights of the Vostok and Voskhod satellite ships is given. Mammals, animal and human tissue cultures, fruit flies, seeds of higher plants, microspores, seaweed cultures, and microbiological and cytogenetic structures were used. The dynamics of spacecraft flight (acceleration, vibration, engine noise, and weightlessness), outer space environment (low barometric pressure, altered gaseous composition in the absence of molecular oxygen and ionizing radiation), and the prolonged life of the organism under the artificial conditions of a spaceship (limited space, features of microclimate, food, and rhythm) were investigated. Biological investigations give the fullest account of the physical features of the unique environment of outer space, and the process of physical investigations important for a successful development of the main trends of space biology. R.W.H.

N65-14606*# National Aeronautics and Space Administration, Washington, D.C.
RESULTS GAINED FROM INVESTIGATING THE BIOLOGICAL EFFECTIVENESS OF A NUMBER OF SPACE FLIGHT FACTORS [REZUL'TATY ISSLEDOVANIYA BIOLOGICHESKOY EFFEKTIVNOSTI RYADA FAKTOROV KOSMICHESKOGO POLETA]
V. V. Parin, V. V. Antipov, B. I. Davydov, G. A. Chernov, and E. F. Panchenkova Nov. 1964 17 p Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Congr., Warsaw, Sep. 7–12, 1964
(NASA-TT-F-9157) OTS: HC $1.00/MF $0.50

Four series of animal experiments on the effects of vertical vibration, accelerations of 10 and 30 G, lethal-dose gamma rays, and a combination of these three factors were made to study the mechanism of compensatory defensive reactions of the organism. Bioassays and spectrophotometric measurements showed decreases in the blood serotonin level by up to 71%, and ceruloplasmin activity was decreased by ionizing radiation and increased by acceleration. Exposure to acceleration or vibration some time before irradiation diminishes the radiation damage and may increase the survival rate. Bone marrow transplants prevented death in some of the animals. Author

N65-14607*# National Aeronautics and Space Administration, Washington, D.C.
MEDICAL STUDIES ON THE COSMIC SPACECRAFTS "VOSTOK" AND "VOSKHOD"
O. Gazenko Dec. 1964 41 p Transl. into ENGLISH of the publ. "Meditsinskiye Issledovaniya na Kosmicheskikh Korablyakh 'Vostok' i 'Voskhod' " Moscow, Akad. Nauk SSSR, 1964 p 1–38 For JPRS transl. see N65-14598 05-04
(NASA-TT-F-9207) OTS: HC $2.00/MF $0.50

A brief summary of the basic results derived from medical (physiological) studies carried out during the flights is presented. The medical studies were concerned with the following: (1) the effect of individual and complex conditions and factors of cosmic flight upon the physiological functions of the organism and the processes by which man adapts to these conditions; (2) the effectiveness and reliability of the life-support systems for rescue and medical monitoring of the atmosphere and the condition of the crew; (3) the efficiency and capabilities of man to carry out different work operations in handling the spacecraft, its systems, and the scientific apparatus; (4) the means and methods by which the resistance of man to the effect of flight factors could be increased; and (5) the value of the criteria and the effectiveness of the methods for selecting cosmonauts and their preparation for flight. P.V.E.

N65-14679# Washington School of Psychiatry, D.C.
FURTHER WORK ON THE USE OF TRACKING TASKS AS INDICATORS OF STRESS Final Report, Jul. 1962–Jan. 1964
Norman K. Walker, Fred Shectman, and Elizabeth De Socio Oct. 1964 141 p refs
(Contract DA-49-193-MD-2369)
(AD-450861)

It is shown that zero input tracking analysis provides a reliable measure of tracking performance, that tracking degrades severely under the stress of auditory shadowing, but that the sensitivity of subjects differs considerably. Auditory shadowing appears to produce similar effects as in combat, possibly in both cases due to an information overload, and hence auditory shadowing may well be a suitable laboratory substitute for combat. Auditory shadowing can thus be used to define the sensitivity of any control system to combat degradation using a given group of subjects, or using a given system to examine the sensitivity of the subjects. Mild electric shocks on the other hand were quite ineffective stressors. Author

N65-14709# Joint Publications Research Service, Washington, D.C.
THE USE OF ULTRASONICS IN MEDICINE
12 Jan. 1965 18 p refs Transl. into ENGLISH from Vorp. Kurortol., Fizioterapii i Lecheb. Fiz. Kul't. (Moscow), v. 29, no. 4, Jul.–Aug. 1964
(JPRS-28255; TT-65-30118) OTS: $1.00

CONTENTS:

1. SOME ASPECTS OF THE MEDICAL USE OF ULTRASONICS A. A. Pushkareva p 1–8 refs
2. THE USE OF ULTRASONICS IN OPHTHALMOLOGY L. Ya. Shereshevskaya p 9–15 refs

N65-14747# Joint Publications Research Service, Washington, D.C.
STUDIES ON THE HUMAN VISUAL ANALYZER AND HEART
11 Jan. 1965 46 p refs Transl. into ENGLISH of 4 articles from Nervnaya Sistema (Leningrad), no. 5, 1964 p 105–122, p 151–158
(JPRS-28234; TT-65-30108) OTS: $2.00

CONTENTS:

1. AN ELECTRORETINOGRAPHIC INVESTIGATION OF THE CRITICAL INTERVAL OF DISCRETENESS OF THE HUMAN VISUAL ANALYZER K. A. Bykov p 1–9 refs
2. INVESTIGATION OF THE INFLUENCE OF EMOTIOFACTORIAL ACTION ON THE EXCITABILITY OF THE VISUAL ANALYSOR OF A HUMAN O. A. Ryabov p 10–17 refs
3. BIOPHYSICS OF THE INTERACTION OF BRIEF COLOR STIMULI IN THE VISUAL ANALYSOR OF A HUMAN E. P. Shaytor p 18–28 refs
4. ELECTRONIC MODEL OF THE HEART V. I. Zabotin p 29–40 refs

N65-14748# Joint Publications Research Service, Washington, D.C.
NEURODYNAMICS OF THE HUMAN AUDITORY SYSTEM
S. N. Gol'dburt 14 Jan. 1965 33 p refs Transl. into ENGLISH from the book "Neurodinamika Slukhovoy Sistemy Cheloveka" Leningrad, Publishing House of Leningrad Univ. 1964 p 167–192, 211–212
(JPRS-28308; TT-65-30133; AD-450346) OTS: $2.00

The dynamic characteristics of the nervous system measure its ability to reflect a variety of external stimuli which are continuously changing according to various parameters. To these dynamic measures, P.O. Makarov added the measurement of various thresholds (intensity, time, and space) of a stimulated structure under condition that the measurement is conducted at the shortest intervals after the preceding stimulus, i.e., in a stimulated state. (Thus arose the conception of the dynamic threshold, and a measurement was made of the dynamic chronaxy of a nerve to various fragments of the excitation process.) On the basis of tests on an altered nerve, N. Ye. Vvedenskiy came to the conclusion in 1901 that, in addition to a running wave of excitation, there exists a slow, gradual excitation, and that this second form of excitation is more general and vital than the first. This report is a broad review of the work in auditory neurophysiology of many investigators in support of the theory of N. Ye. Vvedenskiy as initially stated.
R.W.H.

N65-14761# Washington U., Seattle. School of Medicine
FUNCTIONAL ATELECTASIS AND HYPERINFLATION Annual Progress Report, Oct. 1, 1963–Oct. 15, 1964
John J. Bonica, Richard J. Ward, Fred Danziger, Gerald D. Allen, and John B. Bowes [1964] 12 p
(Contract DA-49-193-MD-2231)
(AD-450346)

Arterial oxygen tensions were determined on a group of healthy young patients breathing oxygen who had been supine for over one hour. The control average oxygen tension was 515-mm Hg. The patients were asked to take a deep breath to the maximum possible, and 5 seconds after the peak of inhalation a second arterial blood sample was withdrawn. A 5-minute period of rest was given and the patients were asked to take a deep breath to the maximum possible and hold it for 5 seconds. Again 5 seconds after peak of inhalation, an arterial blood sample was withdrawn. After a 5-minute rest period, the patients were requested to take 12 deep breaths to the maximum possible. A single deep breath raised the oxygen tension 20-mm Hg. A single breath which was held raised the oxygen tension 64-mm Hg. Twelve maximum deep breaths raised the oxygen tension 48-mm Hg. Author

N65-14803*# Stanford Research Inst., Menlo Park, Calif. Physics Div.
MAGNETIC PROPERTIES OF SOME MACROMOLECULES OF BIOLOGICAL INTEREST Final Report
B. S. Deaver, Jr., J. B. Swedlund, and H. J. Bradley Nov. 1964 49 p refs
(Contract NASr-49(16); SRI Proj. PHU-4644)
(NASA-CR-60122) OTS: HC $2.00/MF $0.50

A new superconducting circuit, together with superconducting magnetic shields and persistent current magnets, was constructed. This apparatus is capable of measuring the magnetic susceptibility of small organic samples at temperatures between 1° and 300° K in fields up to 40 000 G. It can detect flux changes of 10^{-7} G-cm^2, which is equivalent to the capability of detecting a change in specific susceptibility of 10^{-9} in a 100-mg sample under an applied field of 10 kG. Several hundred preliminary measurements were made on samples of coronene. The most reliable of these were in agreement with published values of the magnetic susceptibility of coronene. Experience during these measurements led to changes which have resulted in an apparatus well suited to the measurements on macromolecules. An improved version of the superconducting circuit shows promise of a further improvement in sensitivity by a factor of more than a thousand. Author

N65-14829# Republic Aviation Corp., Farmingdale, N.Y. Paul Moore Research and Development Center
DETERMINATION OF AEROBIC AND ANAEROBIC MICROFLORA OF HUMAN FECES Final Report
Lorraine S. Gall and Phyllis E. Riely Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 87 p refs
(Contract AF 33(615)-1748)
(AMRL-TR-64-107; AD-609325)

Fecal specimens from four young men confined in an experimental activity facility were cultured both aerobically and anaerobically thirteen times during a 6-week period. During certain periods the men wore space suits. Two of the men were on an experimental space-type diet which was freeze-dehydrated. During this same time period the other two subjects were on a "control" diet which contained identical foods, fresh and canned, to duplicate as nearly as possible the dehydrated diet from a nutritional viewpoint. Midway in the experiment the diets of the subjects were switched. The procedures used emphasized the anaerobic isolation of the predominating microorganisms using Gall's specialized technique. The aerobes were isolated

and identified by standard procedures. Although the obligately anaerobic character of the flora remained constant, a shift was found in the types of anaerobic organisms isolated. Author

N65-14941# Naval Training Device Center, Port Washington, N.Y. Human Factors Lab.

BIOLOGICAL EFFECTS OF LASERS: SAFETY RECOMMENDATIONS AND A COMMENT ON THE CONCEPT OF OCULAR DAMAGE

Paul A. Cirincione 28 Jul. 1964 13 p refs
(NAVTRADEVCEN-IH-15; AD-607718)

Since lasers are being increasingly employed and because the laser beam is the most intense artificial light available, questions concerning health hazards to personnel become most important. Several of the most prominent effects, the concept of ocular damage, and proposed safety procedures are presented. The following safety rules are given for laser work: (1) Laser laboratories should be clearly marked as eye hazardous areas. (2) All laser light, regardless of the nature of the laser, should be considered dangerous. (3) Laser laboratories should be brilliantly illuminated to constrict the size of the pupil of the eye. (4) Protective goggles such as the Jena color glass should be worn by all personnel. (5) Interlock systems should be incorporated into lasers so they will not function if anyone is in the light path. E.E.B.

N65-14945*# National Aeronautics and Space Administration, Washington, D.C.

MEMORY OF ANIMALS, ITS NATURE AND ORIGIN [PAMYAT' ZHIVOTNYKH, YEYE KHARAKTERISTIKA I PROISKHOZHDENIYE]

I. S. Beritashvili Jan. 1965 9 p Transl. into ENGLISH of a paper presented at the 10th Congr. of the I. P. Pavlov All-Union Physiol. Soc., Yerevan, 22–28 Oct. 1964
(NASA-TT-F-304) OTS: HC $1.00/MF $0.50

Three types of memory in animals are discussed, a delayed reaction of short duration, a delayed reaction of longer duration, and the long-term memory phenomena associated with conditioned reflexes. Short-term delayed reaction is explained by a closed nerve circuit in which the stimulus from a perception may continue to travel for some time. Delayed reactions of the second type are based on the molecular or submolecular changes in the cytoplasm of the cell and presynaptic endings of the associative pyramidal neurons. The third type of memory is caused by the development of the synaptic endings in the projected pyramidal cells of the pyramidal and extrapyramidal paths. Experiments with removal of the regions of the cortex showed that the prefrontal region is necessary for the retaining and reproduction of images but not for the formation and preservation of conditioned reflexes. The ability at delayed reactions is impaired after bilateral removal of the posterior core from the basal ganglia and the cerebellum. Conditioned reflex activity is disrupted only temporarily by both operations. Author

N65-14946*# National Aeronautics and Space Administration, Washington, D.C.

THE CONDITIONED REFLEX AND PRESENT-DAY NEUROPHYSIOLOGY [USLOVNYY REFLEKS I SOVREMENNAYA NEVROFIZIOLOGIYA]

E. A. Asratyan Jan. 1965 8 p refs Transl. into ENGLISH of a paper presented at the 10th Congr. of the I. P. Pavlov All-Union Physiol. Soc., Yerevan, 22–28 Oct. 1964
(NASA-TT-F-306) OTS: HC $1.00/MF $0.50

This lecture is devoted to a review, a critical analysis, and an evaluation of the factual data of present-day neurophysiology based on the physiology of the conditioned reflex. These data were obtained mainly with the aid of electrophysiological methods, both with and without various modifications on the classical methodology of conditioned reflexes. Moreover, these data concerned three interdependent problems: the process of formation of the conditioned reflex; the characteristics of the functional state of the nerve structures, which are the basis of the closing of the conditioned connection; and the macro- and micro-structural basis of this connection. Author

N65-14947*# National Aeronautics and Space Administration, Washington, D.C.

INVESTIGATION OF THE NEUROPHYSIOLOGICAL MECHANISMS IN THE PROCESS OF EXTERNAL SIGNAL DISCRIMINATION [ISSLEDOVANIYE NEUROFIZIOLOGICHESKIKH MEKHANIZMOV PROTSESSA RAZLICHENIYA VNESHNEGO SIGNALA]

G. V. Gershuni Jan. 1965 8 p Transl. into ENGLISH of a paper presented at the 10th Cong. of the I. P. Pavlov All-Union Physiol. Soc., Yerevan, (USSR) 22–28 Oct. 1964
(NASA-TT-F-307) OTS: HC $1.00/MF $0.50

The effect of the duration of a signal consisting of broadband noise on human and animal discrimination was studied. Discrimination was measured by psychophysical methods, by conditioned reflex methods, by electrical recording from the auditory cortex, and by recording from single cells in the cochlear nucleus. The results suggested three time boundaries which affect the process of discrimination. The first, with an upper limit of 10 to 20 msec, shows little effect of duration on the relation between signal intensity and the measures of discrimination. The second, from 10 to 20 to 80 to 100 msec, has the characteristic reciprocal intensity-duration relationship. The third, above 100 msec, again shows no effect of signal duration on discrimination involving signal intensity. The results are interpreted in terms of short-term memory and evolutionary development. Author

N65-14948*# National Aeronautics and Space Administration, Washington, D.C.

THE SUPPLY OF ENERGY FOR PHYSIOLOGICAL FUNCTIONS [ENERGETICHESKOYE OBESPECHENIYE FIZIOLOGICHESKIKH FUNKTSIY]

S. Ye. Severin Jan. 1965 9 p Transl. into ENGLISH of a paper presented at the 10th Congr. of the I. P. Pavlov All-Union Physiol. Soc., Yerevan, 22–28 Oct. 1964
(NASA-TT-F-300) OTS: HC $1.00/MF $0.50

The provision of energy for physiological functions is described as the result of the accumulation of energy in high-energy bonds, the most important of which is ATP. The various mechanisms of formation of these high-energy bonds are discussed. Glycolysis is considered to be the least efficient method, while oxidative phosphorylation, which is discussed at length, is pointed out to be much more efficient, especially that accompanying the transfer of electrons. The hypotheses recently put forward by Boyer and Skulachev as to the mechanism of oxidative phosphorylation are discussed, as is the role of high-energy phosphate in the mechanisms of muscular contraction. Author

N65-14988# California U., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology

SHORT TERM RETENTION OF STRONTIUM-85 AND ESTIMATION OF INITIAL STRONTIUM-90 BODY BURDENS IN HUMANS

Norman S. Mac Donald, William G. Figueroa, and Marshall R. Urist Dec. 1964 26 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-538)

Following a single intravenous injection, body burdens were measured in a total-body-counter facility at frequent intervals over periods ranging up to several months. Eleven subjects were on metabolic balance regimens in the hospital so that urines and stools were collected and assayed for Sr^{85} and Ca. This group included examples of the extremes of skeletal calcium metabolism including those with avid retention of Ca, normal or balanced cases, and those with large daily loss of endogenous Ca. The amounts of Sr^{85} excreted soon after administration varied widely among individuals and reflected the state of Ca metabolism for each person. Methods for estimating human body burdens of Sr^{90} from bioassay data were reviewed briefly. Applicable data on Sr^{85} urinary excretion vs retention were collected, combined with the present series, and evaluated for utility in estimating Sr^{90} burdens from single urine measurements. Author

N65-15031 Tracor, Inc., Austin, Tex.
BINAURAL INTERACTION Summary Report, 1 Apr. 1963–1 Apr. 1964
Bruce H. Deatherage 8 Jun. 1964 34 p refs
(Contract Nonr-4193(00))
(TRACOR-64-199-U; AD-603766)

Widely divergent theories on binaural interaction, both in localization of external sources and lateralization of earphone-delivered dichotic stimuli, are examined, with the review centering mainly on post-World War II literature in this field. The interrelating characteristics of anatomy, physiology, and psychology are also discussed. To determine what form binaural interaction takes to sounds as different as tone bursts and clicks, several experiments were conducted, with rather inconclusive results. One significant point is that the data for the high-frequency band-pass click are not different from those for the high-frequency low-pass click, despite the expectations that low frequencies in the low-pass click would delay the synchronous timing signal. Listening under equal sensation level conditions, instead of equal sound pressure level, changed the details but not the overall results. Unexplained data are discussed, and it is recommended that the search for equivalence for frequency-disparate stimuli be continued. M.G.J.

N65-15036# Joint Publications Research Service, Washington, D.C.
GENERAL OBSERVATIONS ON SPACE MEDICINE
V. Fomin 22 Jan. 1965 6 p Transl. into ENGLISH from Starshina-Serzhant (Moscow), v. 51, no. 11, Nov. 1964 p 2–3
(JPRS-28417; TT-65-30181) OTS: $1.00

The medical science problems posed by group space flights and interplanetary flights are under study, and some solutions have been reached. The choice of physiological parameters to be measured and the development of a fixation system for numerous sensors needed are discussed, as well as ship-to-earth transmission of high information signals used to relay the condition and dynamics of the physiological functions of the crew members. Under development are the programing of clinical–physiological studies aboard spacecraft and the selecting of crew members on the principle of psychophysiological compatibility. M.G.J.

N65-15039# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
PHYSIO-MECHANICAL EFFECTS OF ACCELERATIONS ON HUMAN BEINGS WORKING IN A ROTATING ENVIRONMENT
Harry C. Crews, Jr. Nov. 1964 38 p refs Revised
(R-63)

The study was initiated because of concern that routine maintenance of radar equipment located in a large rotating room might be impossible. A mechanical analysis was made of accelerations on an object in a rotating enclosure. The results of an experimental program of the Navy are summarized. The results of the mechanical analysis agreed well with the experimental results. The primary object of this report is to provide a method of analysis that can lead to methods and procedures for reducing ill effects on humans. While the study was limited to rotation about one fixed axis, it can be extended to apply to a generally rotating environment. The review of applicable acceleration equations starts from the most general case. Author

N65-15045# Joint Publications Research Service, Washington, D.C.
AN ANALYSIS OF DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM USING ANIMAL EXPERIMENTS—ASSOCIATION AND DISSOCIATION BETWEEN EEG AND BEHAVIOR
Kenichi Yamamoto and Ryonosuke Kido 22 Jan. 1965 28 p refs Transl. into ENGLISH from No to Shinkei (Tokyo), v. 16, no. 1, Jan. 1964 p 44–58
(JPRS-28419; TT-65-30183) OTS: $2.00

Electroencephalographic and behavioral analysis of central nervous system (CNS)-acting drugs on cats, dogs, and monkeys are described. There were no essential differences in the normal EEG patterns between acutely and chronically affected animals, but deep sleep patterns and activated sleep patterns were not seen in acute animals. These patterns, due to differences in experimental conditions, were also observed after administration of some CNS-acting drugs. However, these results show the danger of misunderstanding consciousness levels if only acute EEG patterns are used as the criteria for judgment. After administration of reserpine, meprobomate, and barbiturates, differences of EEG and behavior among cats dogs, and monkeys were not observed. However, "rage-like behavior" was observed only in cats following administration of chlorpromazine. Also, after administration of morphine, cats showed continuous arousal; dogs showed narcosis; and monkeys showed intermediate responses between cats and dogs. R.R.D.

N65-15057*# National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTAL FORMATION OF BIO-LIKE STRUCTURES [EKSPERIMENTAL'NOYE FORMIROVANIYE BIOPODOBNYKH STRUKTUR]
V. O. Kalinenko Jan. 1965 15 p Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 33, no. 2, 1964 p 356–363
(NASA-TT-F-9239) OTS: HC $1.00/MF $0.50

Bio-like structures having the shape of discs, cigars, caudate rockets, etc., are formed in distilled water and on an agar gel in the presence of an electric field. The conditions for the formation of these structures, their behavior, and the nature of their constituent material are discussed. Author

N65-15129# Pennsylvania State U., University Park.
THE INFLUENCE OF BODY CHARACTERISTICS ON HUMAN TEMPERATURE RESPONSES TO HIGH ALTITUDE COLD Progress Report

Paul T. Baker 1 Nov. 1963 32 p refs
(Contract DA-49-193-MD-2260)
(AD-422588) OTS: $2.60

To determine the possible role of body characteristics in man's ability to adapt and acclimatize to high altitude cold, the physical characteristics of four groups of individuals were correlated to their body temperature responses when exposed to an ambient temperature of 14° C for two hours at an altitude of 3760 m. The body characteristics chosen for analysis were age, standing height, sitting height, weight, % body fat, fat-free weight, and sum of skinfold. The four groups were U.S. Whites, University of Cuzco White, and Indian students and native Indian villagers. The results showed significant association between body characteristics and body temperatures in all groups. Fat acted as insulation in all groups and fat-free weight had very significant positive effects on total body heat content. The total body heat content of native Indian villagers was more significantly affected by age than in other groups and fat-free weight in this group had a strong effect on peripheral body temperatures. The result agrees with the previous progress report that native Indian villagers have a higher metabolic response to cold stress. Author

N65-15139*# Naval School of Aviation Medicine, Pensacola, Fla.
HISTOPATHOLOGIC EVALUATION OF A LABORATORY PRIMATE: THE SQUIRREL MONKEY (SAIMIRI SCIUREUS) Report No. 1
Donald E. Furry 15 Aug. 1964 23 p refs Joint report with NASA
(NASA Order A-34681)
(NASA-CR-60193) OTS: HC $1.00/MF $0.50

Tissues from the major organ systems of 15 squirrel monkeys were prepared for microscopic evaluation. Eleven of these primates, initially classified as essentially normal animals, were found to have numerous alterations of tissue structure, reflecting various types of inflammatory and degenerative lesions. The attention of investigators utilizing the squirrel monkey as an experimental animal is directed to the possible existence of acute and chronic lesions in apparently normal animals. Interpretation and evaluation of subtle alterations in function or structure of this primate must be meticulously conducted, and careful histopathological evaluation of major organ systems is an essential requirement for the proper interpretation of a cause–effect relationship. Author

N65-15163*# Consultants and Designers, Inc., Arlington, Va.
DISTURBANCES OF THE MITOSIS MECHANISM IN MICROSPORES OF TRADESCANTIA PALUDOSA INDUCED BY DIFFERENT FLIGHT LENGTHS ON SPACESHIP VOSTOK-5 [VOZNIKNOVENIYE NARUSHENIY MEKHANIZMA MITOZA V MIKROSPORAKH TRADESCANTIA PALUDOSA POD VLIYANIYEM RAZLICHNOY PRODOLZHITEL'NOSTI POLETA NA KORABLE SPUTNIKE VOSTOK 5]
N. L. Delone, V. F. Bykovskiy, and V. V. Antipov 15 Jan. 1965 9 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Biofiz. (Moscow), v. 159, no. 2, 1964 p 439–441
(Contract NAS5-3760)
(NASA-TT-F-9627; ST-SB-10275) OTS: HC $1.00/MF $0.50

Five types of disturbances of the mitosis mechanisms in the microspores of tradescantia paludosa were observed after various lengths of exposure to orbital space flight. Type 1 disruptions kept the nucleus at the cell edge, the nucleus cycle was not disturbed, and a uninuclear cell formed in place of the binucleate pollen. Type 2 disruptions shifted the nucleus in the prophase toward the center of the cell and also formed a uninuclear cell. Type 3 disruptions changed the direction of the spindle axis, and the nuclei of the binucleate pollen were disposed in a plane other than the usual. Type 4 disruptions introduced a nondisjunction of the chromosomes and a lag in telophase. Type 5 disruptions are those at which tripole and quadrupole mitoses occur. The number of cells with mitosis disturbances increased with the duration of the flight. G.G.

N65-15171# Joint Publications Research Service, Washington, D.C.
STUDIES IN SPACE FLIGHT AND PHYSIOLOGY
7 Jan. 1965 14 p Transl. into ENGLISH from Med. Gazeta (USSR), 20 Oct. 1963 p 3
(JPRS-28183; TT-65-30087) OTS: $1.00

CONTENTS:

1. THE PSYCHOLOGY OF GROUP SPACE FLIGHT B. Alyakrinskiy p 1–3 (See N65-15172 05-04)
2. THE PERSONAL HYGIENE OF AN ASTRONAUT L. V. Levashev p 4–6 (See N65-15173 05-04)
3. ADVANCED TRENDS IN THE DEVELOPMENT OF PHYSIOLOGY L. Voronin p 7–11 (See N65-15174 05-04)

N65-15172 Joint Publications Research Service, Washington, D.C.
THE PSYCHOLOGY OF GROUP SPACE FLIGHT
B. Alyakrinskiy *In its* Studies in Space Flight and Physiol. 7 Jan. 1965 p 1–3 (See N65-15171 05-04) OTS: $1.00

Psychological pressures during manned space flight result from sensory deficiencies induced by prolonged weightlessness, from depression due to confinement and isolation in a relatively small restricted enclosure, and from tensions and irritations experienced by a group of people under constant, prolonged, and compulsory communal living. The selection of a crew with similar general peculiarities of temperament and character for greater psychological compatibility in conjunction with a strict regulation of the crew's working and living cycle will increase the stability of the personal relationships and thus ensure a successful performance. G.G.

N65-15173 Joint Publications Research Service, Washington, D.C.
THE PERSONAL HYGIENE OF AN ASTRONAUT
Laureate V. Levashev *In its* Studies in Space Flight and Physiol. 7 Jan. 1965 p 4–6 (See N65-15171 05-04) OTS: $1.00

The personal hygiene of men in space flight is related to the variations in the metabolic processes, the level of human defensive capability, and the biological properties of various microorganisms. The elimination or curtailment of the usual toilet facilities can induce alterations of the human skin and even actual illness. Tests proved that prolonged limitations of the spacemen's mobility changed their skin elasticity in certain areas of the body by a factor of 1 1/2 to 2 in relation to its initial level, and increased the fat deposits on their skin which led to a multiplication of skin microbes and a lowered disinfection mechanism. Variations of the biological equilibrium between the spacemen and the microbes must be avoided by securing hygienic facilities that operate efficiently during prolonged weightlessness in a limited environment. G.G.

N65-15209# Federal Aviation Agency, Oklahoma City, Okla. Neurophysiology Labs.
PHYSIOLOGICAL RECORDING FROM PILOTS OPERATING AN AIRCRAFT SIMULATOR

Carlton E. Melton, Jr. Sep. 1964 12 p refs
(AM-64-18)

Ten physiological records were obtained from each of six pilots performing simulated flight problems in a C-97 aircraft simulator. The pilots were given therapeutic doses of either a tranquilizer (meprobamate) or an antihistamine (chlorpheniramine) during three of the simulated flights, the others being training or control flights. Records were made of electrocardiogram, heart rate, respiratory rate, galvanic skin response, electroencephalogram (parietal–occipital), electroencephalogram (frontal–central) and lateral eye movements (electrooculogram). None of the variability of the above parameters, with the exception of the electroencephalograms (to be separately published), was ascribable to drug treatment. The techniques developed during this study are suitable for physiological recording from subjects in the work situation. Author

N65-15262# Air Force Systems Command, Brooks AFB, Tex. Aerospace Medical Div.
HIGHLIGHTS OF FOREIGN BIOASTRONAUTICS, VOLUME 1, NO. 15, 16 JUNE 1964
[1964] 24 p refs Presented at COSPAR Symp., Florence, 8-20 May 1964
(AMD-TR-64-10; AD-450336)

A survey of the results of a number of bioscience experiments performed in Soviet spaceships is presented. Described are the fixing of biological specimens in space flight, the biopackages on board the Vostolk -5 and -6 vehicles that included Lysogenic culture E. coli K-12 (λ), seeds of higher plants, Tradescantia paludosa, different strains of Chlorella, fruit flies, and HeLa cell cultures. The total absorbed radiation dose of the cosmonauts was studied and found biologically insignificant (< 1 mrad/2 hrs). Observed changes at the cellular level of Tradescantia paludosa appeared to be related to prolonged weightlessness. It was concluded that weightlessness of a 5-day duration does not affect the life functions of several different organisms. The probable need of artificial induced gravity for long-duration manned space flights should be investigated. G.G.

N65-15269# Air Force Systems Command, Brooks AFB, Tex. Aerospace Medical Div.
HIGHLIGHTS OF FOREIGN BIOASTRONAUTICS, VOLUME 2, NO. 4
8 Oct. 1964 15 p refs
(AMD-TR-64-16; AD-450339)

Presented is a program of experiments by the Soviets which is designed to establish the biological basis for man's long-term survivability in space. The program includes both ground-based laboratory research and experiments performed in high-altitude rockets and orbital vehicles. The effects of acceleration, vibration, noise, high temperature, reduced gravity, prolonged isolation, and ionizing radiation on numerous biological specimens were studied. Dogs were selected as the principal biological specimens for investigating the effects of space flight. Test results showed that blood circulation and respiration parameters returned to initial values within 5 to 6 minutes after exposure to weightlessness. It was concluded that the stresses of space flight can be tolerated by animals. Also included in this study is a bibliography of published Soviet reports on the results of satellite biological experimentation. R.R.D

N65-15277# Naval School of Aviation Medicine, Pensacola, Fla.
QUANTITATIVE INTERPRETATION OF THE EXERCISE ELECTROCARDIOGRAM: USE OF COMPUTER TECHNIQUES IN THE CARDIAC EVALUATION OF AVIATION PERSONNEL
Raphael F. Smith 4 Nov. 1964 21 p refs
(Rept.-3; AD-609444)

Exercise stress tests improve the sensitivity of the ECG as a method of detecting coronary heart disease, but a high diagnostic error rate has been associated with currently accepted methods. This report describes a system of quantitating ECG changes after exercise, which utilizes a special purpose analog computer (integrator) and calculation of mean VCG parameters by digital computer. Highly significant changes in the direction of the T vector appear three minutes after exercise and allow separation of the normal subjects from patients with mild angina pectoris. The quantitative output of this system is being used in an epidemiological approach to the problem of coronary disease in the aviator. Author

N65-15308# Federal Aviation Agency, Oklahoma City, Okla. Psychology Labs.
AVIATION MEDICINE TRANSLATIONS: ANNOTATED BIBLIOGRAPHY OF RECENTLY TRANSLATED MATERIALS, II
Jerry V. Tobias, William E. Collins, and Mary Ellen Allen Oct. 1964 13p refs
(AM-64-16)

An annotated bibliography of translations of foreign-language research articles is presented. The 27 listed entries are concerned with studies of auditory fatigue, auditory malingering, voluntary nystagmus, vestibular function, objective and subjective fatigue, drugs, and forensic science. Procedures for obtaining copies of the translations are included. Author

N65-15346# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine
EFFECTS OF BILATERAL CALORIC HABITUATION ON NYSTAGMUS RESPONSES OF THE CAT
Mary Jayne Capps and William E. Collins Sep. 1964 24 p refs
(AM-64-14)

Transfer of bilateral caloric nystagmus habituation to unilateral calorization was investigated in a group of 60 cats. Habituation to bilateral caloric irrigations markedly reduced responses to both less intense and more intense unilateral stimulation. Subsequent testing provided information concerning the effects of caloric habituation on directional specificity of response, retention of the response decline, and optokinetic nystagmus. Statistical analyses also indicated a sex difference in response magnitude. Author

N65-15352# Joint Publications Research Service, Washington, D.C.
ANTITUMOR ALKALOIDS OF VINCA ROSEA LINN
A. Ya. Krashilina 25 Jan. 1965 16 p refs Transl. into ENGLISH from Probl. Gematol. i Pereliv. Krovi (Moscow), v. 9, no. 12, Dec. 1964 p 26-33
(JPRS-28448; TT-65-30197) OTS: $1.00

The properties of vincaleukoblastin and vincrystine, antitumor alkaloids of vinca rosea linn, were discussed, and the results of clinical tests and animal experiments in treating leukemia and some forms of tumors were given. Vincaleukoblastin proved most effective in cases of acute leukemia, lymphogranulomatos and chorioncarcinoma, which did not

respond to usual therapy. However, the therapeutic result was relatively brief, and an effective dose bordered on toxic levels. Vincrystine showed some effectiveness in treating resistant forms of acute lympholeukemia in children, and some promise for resistant forms of lymphogranulomatosis. A brief literature survey of other antitumor plant derivatives was also given. M.G.J.

N65-15353# Joint Publications Research Service, Washington, D.C.
THE EFFECT OF GRAVITATIONAL STRESS ON THE ARTERIAL WALL
R. A. Bardina 26 Jan. 1965 8 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Leningrad), v. 47, no. 11, Nov. 1964 p 41–44
(JPRS-28476; TT-65-30204) OTS: $1.00

Experiments to study the structure of the femoral arterial wall were conducted on rabbits, revolving on an electric centrifuge with the head directed to the center. Speed was 70 to 75 rpm, with a stress of 5 to 6 g in the head-pelvis direction. The influence of marked single stress and prolonged stress on the vascular wall structure was studied, and the arterial wall was examined at intervals to investigate the reversibility of these vascular changes. It was shown that stress exerts a strong, lasting effect on intramuscular arterial walls, and that although macroscopic changes in neural vessels disappear several days after termination of stress, microscopic changes persist for a considerably longer period. M.G.J.

N65-15355# Joint Publications Research Service, Washington, D.C.
NEW STRESS FACTORS FOUND IN 120-DAY SEALED CHAMBER TESTS
A. L. Lebedinskiy et al 27 Jan. 1965 7 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 9 Oct. 1964 p 4
(JPRS-28490; TT-65-30210) OTS: $1.00

Sealed chamber tests lasting from 10 to 120 days were performed to study the physiological effects of a closed simulated space system on man. The carbon dioxide content in the cabins rose from 10% to 20% above normal, and changes developed in the human respiratory–cardiovascular mechanism. Disturbances of the nocturnal sleep pattern, reduction in work efficiency, and inhibition of the cerebral cortex processes took place. The addition of radiation and noise factors to the test pattern increased the human excretion of amino-acid compounds to 80%. Ventilation of the chamber with external air eliminated almost all physiological changes. The additional purification of the air from bacteria and harmful chemical impurities, the ultraviolet irradiation of the skin of the subjects, the intake of increased amounts of vitamins, the performance of special physical exercises, and the use of various medicinal agents promoted a substantial reduction of undesirable effects. G.G.

N65-15368*# Texas U., Dallas. Southwestern Medical School
[INFLUENCE OF GRAVITY ON UNICELLULAR ORGANISMS AND OPTIMIZATION OF THE ULTRAVIOLET FLYING-SPOT MICROSCOPE FOR LIVING CELL OBSERVATIONS] Semiannual Status Report, Apr. 1–Sep. 30, 1963
Dale Jenkins [1963] 5 p
(Grant NsG-210-63)
(NASA-CR-51799) OTS: HC $1.00/MF $0.50

Research progress is reported in studies of gravitational and radiation effects on unicellular organisms and in the development of microscopic techniques for observing living cells. Preliminary investigations of the cell enlargement and the failure of cell division noted in bacteria subjected to 110 000 g for 24 hours indicate that these gravitational changes are of a genetic nature. Bacteria subjected to 24 hours of continuous X-irradiation from a cobalt-bomb source, which delivers 2 r per minute, show ultrastructural changes that appear to be identical to those induced by gravity. Centrifuge microscope studies of amoeba subjected to continuous 20 or 40 g for as long as 5 weeks indicate that no change occurs in growth rate or ability to trap and ingest food. The design of equipment for inflight studies is proceeding with the establishment of optimum media mixtures and cell populations for each culture chamber. A new amplifier improved the signal-to-noise ratio and the stability of the ultraviolet flying spot television microscope. M.P.G.

N65-15369*# Dartmouth Coll., Hanover, N.H.
EFFECTS OF PLANT GROWTH HORMONES ON PLANT DEVELOPMENT IN THE ABSENCE OF GRAVITATIONAL EFFECTS Third Semiannual Status Report, Sep. 1, 1963–Feb. 29, 1964
Charles J. Lyon 6 Mar. 1964 4 p
(Grant NsG-231-62)
(NASA-CR-53405) OTS: HC $1.00/MF $0.50

Techniques of extraction and radioassay were used to demonstrate the unbalanced supply of auxin to the convex and concave sides of a leafy plant whose axis exhibited growth curvature due to absence of gravity. More auxin moved into the tissues that became the convex side of the curvature. Similar experiments were performed to provide evidence for the downward transport of auxin within the stem system of a mature, branched plant. R.L.K.

N65-15372*# Oklahoma City U., Okla.
METABOLIC STUDIES ON ANIMALS IN OXYGEN AT A SIMULATED ALTITUDE OF 26,000 FEET
John Patrick Jordan, John B. Allred, Charles L. Cahill, and Robert T. Clark [1963] 23 p Presented at the Aspen Conf. on Adaptation to Unusual Atmospheres, Colo., 12–15 Jun. 1963
(Grant NsG-300-63)
(NASA-CR-60338) OTS: HC $1.00/MF $0.50

The effect of a 93% oxygen environment at an atmospheric pressure of 5.22 psi on the metabolic activity of rats was investigated. After daily 8-hour exposures to this environment for 34 days, the experimental and control animals were sacrificed. No differences in body weight, organ weight, or gross body composition were noted. The serum proteins from each group were pooled by aliquot, and quantitative analysis indicated that the experimental animals contained only one-half the amount of lipoprotein that the controls contained. Radiocarbon tracer techniques indicated that the experimental animals metabolized progressively slower than the controls as the experiment progressed. An analysis of liver lipids suggests that fatty acid synthesis is drastically reduced with a corresponding increase in total tissue lipid. It was concluded that metabolism in general is reduced by 10% or more, that no metabolic adaptation to the oxygen environment occurred, and that metabolic alterations could not be repaired during the 16 hours in a normal environment. Author

N65-15373*# Maryland U., College Park. Space Research Labs.
BEHAVIORAL RESEARCH AND EXPERIMENTAL ANALYSIS OF COMPLEX BEHAVIORAL REPERTOIRES UNDER FULL ENVIRONMENTAL CONTROL Semiannual Status Report, Aug. 1, 1963–Jan. 31, 1964

Joseph V. Brady and William Hodos [1964] 13 p refs
(Grant NsG-189-61)
(NASA-CR-53475) OTS: HC $1.00/MF $0.50

In the studies of the neurophysiological correlates of behavior, EEG data that were collected during complex performances by monkeys were processed by a computer to yield an analysis of the number and percent of zero crossings of the EEG. A stereotaxic atlas of a pigeon's brain was prepared, and a technique was devised for photographing wet, unstained brain sections in preparation for a study of the effects of brain lesions and stimulation on the performance level. In investigations of behavior under conditions of total environmental control, a study of pigeons indicated that the effects of confinement did not impair the performance of a complex behavioral sequence. Ways of assessing behavior and performance changes during space flight are also being developed with the Nimestrina monkey, cats, and pigeons. Studies with chimpanzees indicated that there are no impairments of performance during long-term isolation. R.L.K.

N65-15378*# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF *PEROGNATHUS* AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY
Progress Report, 1 Oct. 1963–31 Dec. 1964
R. G. Lindberg and J. J. Gambino [1964] 129 p refs
(Contract NASw-812)
(NASA-CR-60319; NSL-64-29-5) OTS: HC $4.00/MF $1.00

The pocket mice *Perognathus longimembris* that received lethal whole-body gamma irradiation at two different times of a day showed different responses to irradiation. Those irradiated in the morning during their period of low metabolism had an ST_{50} of 11 days. Those irradiated at night during their metabolic high period had an ST_{50} of 15 days. The morning-irradiated animals were all dead by the 18th day of postirradiation. Several night-irradiated animals were alive at 30 days of postirradiation. The relationships of radiation sensitivity to metabolic activity, mitotic activity, and cell population kinetics of critical regenerative tissues are discussed. Studies on the following subjects are also presented: (1) mechanisms of radiation resistance in mice; (2) measurement of the rate of oxygen consumption of *Perognathus longimembris* under different conditions of ambient temperature, lighting, food supply, composition of the atmosphere, and physiological conditioning; and (3) prolonged orbital flight effect on the circadian rhythms of pocket mice. R.R.D.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-14525# Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
HUMAN ENGINEERING IN THE DESIGN OF INSTRUCTIONAL SYSTEMS
Sylvia R. Mayer Sep. 1964 17 p refs
(ESD-TDR-64-454; AD-609368)

A conceptual model is proposed for use in the application of human engineering principles and techniques to the design of instructional systems. The trainee and instructor are viewed as operators within an information system. To illustrate this model and its application, examples are drawn from the literature and from current research on instructional systems. A preliminary human engineering guide is outlined which presents factors critical to design decisions for instructional systems. The model and guide attempt to counteract current tendencies toward premature standardization of instructional system structure, and to bring instructional system development into the mainstream of the applied science of human engineering. Author

N65-14557# Mount Holyoke Coll., South Hadley, Mass.
THE RANGE OF VISUAL SEARCH Final Report
John Volkmann, Horace H. Corbin, Nancy B. Eddy, and Carol Coonley Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1964 105 p refs
(Contract AF 19(604)-3037)
(ESD-TDR-64-535; AD-608810)

The process of visual search in its early phases was studied. Individual human subjects searched in a projected matrix of elements for one element unlike the rest, e.g., for a triangle in a matrix otherwise composed of circles. In the method of lasting exposure, the matrix was exposed until the subject responded, and the dependent variable was the latency of the response. In the method of brief exposure, the exposure time was limited, and the dependent variables were the percentage of positive responses and the latency of the positive responses. Among the independent variables in various experiments were the following: (1) the total number of elements in the matrix; (2) the type of discrimination (form, area, color); and (3) the external form and internal pattern of the stimulus array. In analyzing the results of a typical experiment, the medium latency is plotted as a function of the number of elements in the stimulus array. Author

N65-14578# Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM *PROBLEMY KIBERNETIKI* (PROBLEMS IN CYBERNETICS), NO. 11, 1964
11 Dec. 1964 213 p refs Transl. into ENGLISH of 8 articles from Probl. Kibernetiki (Moscow), No. 11, 1964 p 5–24, 147–151, 153–187, 189–198, 215–244, 276–279
(JPRS-27792; TT-64-51913) OTS: $6.00

CONTENTS:

1. G. V. SAVINOV A. Yu. Ishlinskiy p 1–10 refs

2. A MATHEMATICAL-MODELING STUDY OF THE INTERRELATIONSHIP BETWEEN THE NEURAL PROCESSES EXCITATION AND INHIBITION G. V. Savinov, L. V. Krushinskiy, D. A. Fless, and R. A. Velershteyn p 11–35 refs (See N65-14579 05-05)

3. THE BIOGEOCOENOLOGICAL LEVEL OF CONTROL WITHIN THE BIOSPHERE A. A. Lyapunov and I. V. Stebayev p 36–42 (See N65-14580 05-05)

4. THE PROBLEM OF REGULATION, INSPECTION AND CONTROL, VIEWED NEUROPHYSIOLOGICALLY G. I. Polyakov p 43–68 (See N65-14581 05-05)

5. DESCRIPTION OF THE PROGRAMS OF AN ALGORITHM FOR TRANSLATION FROM ENGLISH INTO RUSSIAN G. P. Bagrinovskaya p 69–109

6. FREQUENCY DISTRIBUTION OF INFLECTIONAL CLASSES OF RUSSIAN WORDS G. G. Belonogov p 110–130 refs

7. PROPERTIES OF CORRECT SYNTACTIC STRUCTURE AND AN ALGORITHM FOR ITS DETECTION (RUSSIAN-LANGUAGE MATERIAL) L. N. Iordanskaya p 131–195 refs

N65-14579 Joint Publications Research Service, Washington, D.C.

A MATHEMATICAL-MODELING STUDY OF THE INTERRELATIONSHIP BETWEEN THE NEURAL PROCESSES EXCITATION AND INHIBITION

G. V. Savinov, L. V. Krushinskiy, D. A. Fless, and R. A. Velershteyn *In its* Transl. from Probl. Kibernetiki (Probl. in Cybernetics), No. 11, 1964 11 Dec. 1964 p 11–35 refs (See N65-14578 05-05) OTS: $6.00

Mathematical modeling of the interrelationship between the fundamental processes of excitation and inhibition in neural activity is based on the following assumptions. The living organism has different circuits (pathways) for conducting signals. Along one circuit, the stimulus (input) causes the reaction (output). An amplifier with nonlinear characteristics to reflect inhibition is inserted into this circuit. Amplification of the excitation signal moves along the other, or positive feedback, circuit, which has to be integral (cumulative). Interaction of both circuits makes explanation of the phenomena possible. In principle, the model consists of circuits analogous to circuits of the nervous system. Impulses move along one circuit through a nonlinear amplifier to the output, corresponding to the specific afferent and efferent pathways to the appropriate nerve center. The positive feedback circuit integrally raises the voltage at input of the nonlinear amplifier. This circuit corresponds to the reticular formation with its tonic type of activation. Thus, an analogy can be drawn between the circuits of the model and the functional structures of the nervous systems. M.G.J.

N65-14580 Joint Publications Research Service, Washington, D.C.

THE BIOGEOCOENOLOGICAL LEVEL OF CONTROL WITHIN THE BIOSPHERE

A. A. Lyapunov and I. V. Stebayev *In its* Transl. from Probl. Kibernetiki (Probl. in Cybernetics), No. 11, 1964 11 Dec. 1964 p 36–42 (See N65-14578 05-05)
OTS: $6.00

From the viewpoint that a biogeocoenosis includes living organisms performing certain functions and inert matter creating the physicogeographical setting in which these organisms exist, conditions of existence depend on their interactions with each other. A synousia, or group of organisms, regulates the streams of matter distributed in strictly defined habitats of the same type. As each synousia converts a certain substance from one state to another and exploits this change for its own existence, it acts as an elemental control device in the biogeochemical cycle providing the material for a given biogeocoenosis. Although the species may be both homogeneous and inhomogeneous, or phylogenetically remote from one another, they must adapt to similar functions and possess specific characteristics to perform within the biogeocoenosis. Several examples of the effect which external conditions have on the synousia and the performance of various synousia structures are given. M.G.J.

N65-14581 Joint Publications Research Service, Washington, D.C.

THE PROBLEM OF REGULATION, INSPECTION AND CONTROL, VIEWED NEUROPHYSIOLOGICALLY

G. I. Polyakov *In its* Transl. from Probl. Kibernetiki (Probl. in Cybernetics), No. 11, 1964 11 Dec. 1964 p 43–68 (See N65-14578 05-05) OTS: $6.00

Concrete definitions and analyses of the development of the nervous system during the evolution of animal organizations are presented, with particular emphasis on the functions of regulation, self-regulation, inspection, self-inspection, control, and self-control. As a result, six different functions with an anatomicophysiological mechanism corresponding to each function are obtained. The significance of the coordination mechanism and analyzers, and their relationship to the complexities of the nervous system, are also incorporated into the study. The influence on these six functions of the centralized ganglionic nervous system, the chief analyzer systems and their connections with the coordination mechanism, neuron organization of brain-sited portions of analyzers, correlation between neurons, anatomic correlations and connections of central nervous formations, transmission of voluntary control impulses from cerebral cortex to reflex centers of brain stem and spinal cord, and from different parts of the cerebral cortex to the analyzer-coordination mechanism (cerebellum), is also discussed. M.G.J.

N65-14710# Joint Publications Research Service, Washington, D.C.

SOME INDIVIDUAL DIFFERENCES IN THE ACTIVITY OF A SPORTSMAN-ACROBAT AND THEIR CONSIDERATION IN TEACHING AND TRAINING EXERCISES

B. I. Yakubchik 13 Jan. 1965 19 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 5, 1964 p 20–30 (JPRS-28276; TT-65-30122) OTS: $1.00

An attempt is made to single out and describe the (individual) features of three sportsmen-acrobats which would most likely depend on the general typological properties of their nervous system. The possibility of using these observations in formulating a method of individualized approach in the process of training sportsmen of the highest caliber is discussed. P.V.E.

N65-14797# American Inst. for Research, Palo Alto, Calif.

STUDY OF TRAINING PERFORMANCE EVALUATION TECHNIQUES

David Angell, James W. Shearer, and David C. Berliner 16 Oct. 1964 82 p refs
(Contract N61339-1449)
(NAVTRADEVCEN-1449-1; AD-609605)

The report discusses performance evaluation in the training environment, specifically in training situations involving the use of simulators and other complex training equipment. The important variables involved in developing a system of performance evaluation are seen as types of behaviors, types of measures or mensural indices, and types of instruments for recording performance. Factors relating to these variables are discussed, and some of their interrelationships are delineated. Matrices which facilitate the consideration of interrelationships among the three variables are presented. An illustrative application of an automatic training–evaluation system is given. Author

N65-14848*# Space Technology Labs., Inc., Redondo Beach, Calif.

A STUDY OF MODEL MATCHING TECHNIQUES FOR THE DETERMINATION OF PARAMETERS IN HUMAN PILOT MODELS

G. A. Bekey, H. F. Meissinger, and R. E. Rose Washington, NASA, Jan. 1965 170 p refs
(Contract NAS1-2582)
(NASA-CR-143) OTS: HC $5.00/MF $1.00

The study departs from conventional approaches where the pilot is characterized by transfer functions or quasi-linear describing functions, progressing into the domain of time-variant and nonlinear operations and representative models of this type.

Manual tracking in two axes where the operator is modeled as a multiple input–multiple output system is discussed. The emphasis has been placed primarily on development of computational methods and, hence, model matching experiments on synthetic pilots with known parameters were required. The resulting methodology was successfully applied to actual pilot tracking data and provided new insight into the pilot's dynamic response. The experimental results are presented. A part of the study was devoted to the comparison of continuous and iterative parameter adjustment methods. In addition, significant analytical results were derived pertaining to the nature of parameter optimization by the gradient method. Author

N65-15105# Human Factors Research, Inc., Los Angeles, Calif.
GEOGRAPHIC ORIENTATION IN AIRCRAFT PILOTS: EXPERIMENTAL STUDIES OF TWO CARTOGRAPHIC VARIABLES
James J. Mc Grath, William E. Osterhoff, and Gail J. Borden Nov. 1964 56 p refs
(Contract Nonr-4218(00))
(TR-751-3; AD-609092)

Two experiments were conducted to study the influence of cartographic variables on geographic orientation performance of pilots of light attack aircraft. A cinema method was used to simulate the visual aspects of low-altitude, VFR, navigation. The results of the first experiment showed that the removal of place names from a sectional aeronautical chart produced no significant change in orientation performance. The second experiment showed that a change in chart scale, when information content remained the same, produced no significant change in orientation performance. However, a comparison of performances using the sectional aeronautical chart and using the USAF Operational Navigation Chart showed that a change in scale, when accompanied by a change in information content, produced a significant change in orientation performance. Implications of the results for navigation display design were discussed. Author

N65-15112# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMULATION OF TOUCH BY MEANS OF SURFACE ULTRASOUND WAVES
L L. Myasnikov 15 Oct. 1964 6 p refs Transl. into ENGLISH from Tr. Leningr. Korablestroitel'nogo Inst. (Leningrad), no. 36, 1962 p 103–105
(FTD-TT-64-225/1; AD-607496)

The method of simulating touch is based on the use of surface ultrasonic waves of the megacycle range that are radiated in the form of impulses and that pass around the surface of an "artificial finger." The intensity and the sequence of the perceived impulses change, depending upon the contact with the "feeling" object, the degree of pressure, and the form of the object. By changing the ultrasonic impulses into electrical ones and by using scanning and resolution, an image characterizing the result of the "feeling" is obtained on the screen of an electronic oscillograph. R.R.D.

N65-15148*# Army Biological Labs., Fort Detrick, Md. Physical Defense Div.
THE LEVEL OF MICROBIAL CONTAMINATION IN A CLEAN ROOM DURING A ONE YEAR PERIOD Protection Branch Report of Test No. 11-65
Dorothy M. Portner 4 Dec. 1964 20 p
(NASA Order R-35)
(NASA-CR-60184) OTS: HC $1.00/MF $0.50

A study to determine the level of microbial contamination in a clean room was undertaken in order to establish a basis for deciding whether it is advantageous from a minimal microbial contamination standpoint to assemble a spacecraft in such an area. To increase the probability of obtaining a sterile spacecraft with a given sterilization procedure, precautions must be taken to keep the initial microbial population as low as possible. The level of aerobic microbial contamination that accumulates on surfaces from aerial fallout and also from handling was previously investigated, but a more extensive study was needed under clean room conditions. Author

N65-15169# Federal Aviation Agency, Washington, D.C. Georgetown Clinical Research Inst.
STUDIES ON AGING IN AVIATION PERSONNEL
Arthur E. Wentz Aug. 1964 16 p
(AM-64-1)

Investigative work is in the cardiovascular, neurological, pulmonary, vision and auditory, and biochemical systems. Behavioral tasks are incorporated in the individual survey. Subjects for studies are selected from aviation personnel. Significant numbers for each 10-year age group will be examined annually for buildup of individual profiles. Consecutive studies at the Institute should develop techniques for rating physiological aging in individuals; for evaluating and detecting pathological states at earliest age; and to aid in formulating physical standards by physiological rather than chronological age, in aviation personnel. Author

N65-15187*# United Aircraft Corp., Farmington, Conn. Corporate Systems Center
ENGINEERING MAN FOR SPACE. THE CYBORG STUDY Final Report
Robert W. Driscoll 15 May 1963 188 p refs
(Contract NASw-512)
(NASA-CR-60273) OTS: HC $5.00/MF $1.25

A study has been conducted to gather data pertaining to limitations on man's adaptability to long-term space flights and to possible methods for considerably reducing life support problems during such flights. Specifically the applicability of artificial organs, drugs, and hypothermia during such flights is considered in detail. In addition, the study on the development of a mathematical and dynamic model of the human heart and cardiovascular system in a space environment is included. Author

N65-15317# System Development Corp., Santa Monica, Calif.
METHODOLOGY FOR USE IN CONJUNCTION WITH OPERATIONS SIMULATION FOR IDENTIFYING AND DEFINING CRITICAL TASK-PERFORMANCE VARIABLES
Paul R. Christensen 8 Sep. 1964 14 p refs
(SP-1761/000/00; AD-450710)

Research methodology to discover critical task-performance variables that are meaningful, measurable, independent, and relatable to task and operator performance and skills, is used to analyze the deghosting function of the passive tracking subsystem in SAGE. Three studies in sequence are necessary. The first entails an analysis of the task elements and subsystem variables, and synthesis of these elements with the task dimensions and subsystem variables. This serves as a basis for the second, in which the redefined task skills and elements are analyzed. The resulting dimensions are synthesized so that they converge as nearly as possible to a hypothesized set of skills. In the third study, the task, skills and subsystem variables are reanalyzed, with synthesis accomplished by using a sample of subsystem personnel skills and operations simulation. The common ingredients from tasks, skills, and subsystem variables are then drawn together. M.G.J.

N65-15416# Defense Atomic Support Agency, Washington, D.C. Training Div.
RADIOLOGICAL EMERGENCY PROCEDURES FOR THE NON-SPECIALIST
Karl F. Oerlein Washington, AEC, May 1964 40 p Prepared for the Interagency Comm. on Radiological Assistance
GPO: $0.35

Described are the radiological hazards due to the increased applications of radioactive materials for peaceful as well as defense purposes. Despite strict regulations designed to insure the safe handling and shipping of such materials, there always is the possibility that someone not associated with radioactive substances may find himself at the scene of an accident involving such materials. This report provides fundamental and reliable information that the ordinary layman can use for guidance in taking immediate action in case of an accident of this type. Discussed are familiar and unfamiliar hazards, the understanding of nuclear radiation, conventional and nuclear weapons, accidents involving radioactive materials, emergency measures, and the sequence of emergency procedures. R.R.D.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-14488# Dynatech Corp., Cambridge, Mass. Advanced Processes Dept.
STUDY OF OXIDES FOR O_2-N_2 SEPARATION Seventh Quarterly Progress Report, 15 Jul.–15 Oct. 1964
30 Oct. 1964 18 p
(Contract AF 33(657)-10797)
(Rept.-506; AD-607693)

The objective of this program is the development of reactant particles suitable for application in a high-temperature oxygen–nitrogen separator device. It is desirable to start with a uniform particle size distribution raw material. Such material must be prepared under controlled conditions, and must be partially sintered or "dead burned" to prevent excessive sintering. For cobalt oxide, the desired particle size is of the order of 1μ to 0.25μ diameter. The testing of the reactant particles obtained to date has continued on schedule. Five rotary disc separator tests were performed during this period. The performance of pure cobalt oxide, supported cobalt oxide, and supported paladium particles was measured. R.W.H.

N65-14630*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF TEMPERATURE BUFFERED ARGON ARC IN SPECTROGRAPHIC TRACE ANALYSIS
William A. Gordon Washington, NASA, Jan. 1965 19 p refs (NASA-TN-D-2598) OTS: HC $1.00/MF $0.50

A new and widely applicable procedure is described for improving the lower limits of detection of trace elements by emission spectroscopy. A special gas-tight chamber was used that permits the arcing of specimens in a static atmosphere of argon at pressures from 100 to 7500 torr. Observations of the physical features of the argon arc in this pressure range are reported. The criterion used to establish the optimum arcing conditions was the measurement of the line-to-background intensity ratios. Experimental parameters were studied to determine conditions for maximizing the elemental line intensities and minimizing the background radiation. The sensitive neutral atom lines are enhanced in this system, and the characteristic ion spectra of the argon arc are suppressed by vaporizing a few milligrams of certain metal salts into the discharge with the sample. Author

N65-14636# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
WORKING GROUP ON THERMOCHEMISTRY, PROCEEDINGS OF SECOND MEETING, VOLUME I
T. L. Reedy et al Aug. 1964 117 p refs Meeting held at Atlantic Res. Corp., Alexandria, Va., 3–4 Jun. 1964
(Contract NOw-62-0604-c)
(CPIA Publ.-54; AD-451711)

CONTENTS:

1. A SURVEY OF IONIZATION POTENTIALS OF COMBUSTION PRODUCTS L. K. O'Bryan and B. Brown (Boeing Co.) p 1–12 refs (See N65-14637 05-06)

2. SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES D. D. Wagman (Natl. Bur. of Standards) p 13–34 ref (See N65-14638 05-06)

3. RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS P. E. Blackburn (Arthur D. Little, Inc.) p 35–41 refs (See N65-14639 05-06)

4. RECENT PROGRESS IN FLUORINE CHEMISTRY J. L. Margrave (Rice U.) p 43–50 refs (See N65-14640 05-06)

5. PROGRESS REPORT FROM THE THERMODYNAMICS GROUP W. D. Good, J. F. Messerly, and D. R. Douslin (Bur. of Mines) p 51

6. CALORIMETRIC INVESTIGATION OF ALUMINUM BOROHYDRIDE A. A. Gilliland and D. D. Wagman (Natl. Bur. of Standards) p 53

7. RECENT WORK AT ARTHUR D. LITTLE A. Buchler (Arthur D. Little, Inc.) p 55–66 refs (See N65-14641 05-06)

8. RECENT STUDIES OF THERMODYNAMIC PROPERTIES OF SOME BERYLLIUM AND ALUMINUM SPECIES T. B. Douglas (Natl. Bur. of Standards) p 67–72 refs (See N65-14642 05-06)

9. CALORIMETRY OF BERYLLIUM COMPOUNDS G. T. Armstrong (Natl. Bur. of Standards) p 73–78 refs (See N65-14643 05-06)

10. RECENT THERMODYNAMIC STUDIES OF LIGHT-METAL COMPOUNDS D. L. Hildenbrand (Aeronutronic) p 79–83 refs (See N65-14644 05-06)

11. RECENT CALORIMETRIC STUDIES OF BERYLLIUM FLUORIDE A. R. Taylor, Jr. (Bur. of Mines) p 85–86 (See N65-14645 05-06)

12. THE INFRARED SPECTRA OF MAGNESIUM AND ALUMINUM FLUORIDES BY MATRIX ISOLATION M. J. Linevsky (Gen. Elec. Co.) p 87–96 refs (See N65-14646 05-06)

13. INFRARED SPECTRA BY MATRIX ISOLATION OF SOME LOW-MOLECULAR-WEIGHT INORGANIC HALIDES A. Snelson (IIT Res. Inst.) p 97–104 refs (See N65-14647 05-06)

14. SPECTROSCOPY OF TRANSITION-METAL OXIDES IN NEON AND ARGON MATRICES AT 4° AND 20° K W. Weltner, Jr. (Union Carbide Res. Inst.) p 105–107 refs (See N65-14648 05-06)

15. SOME ASPECTS OF HIGH-TEMPERATURE MATRIX-ISOLATION SPECTROSCOPY D. E. Mann (Natl. Bur. of Standards) p 109–115 refs (See N65-14649 05-06)

N65-14637 Boeing Co., Seattle, Wash.
A SURVEY OF IONIZATION POTENTIALS OF COMBUSTION PRODUCTS

Lynda K. O'Bryan and Billings Brown *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 1–12 refs (See N65-14636 05-06)

A brief survey was made concerning the desirability of adding the compilation of thermochemical data of ionic species to the JANAF tables. From this brief survey, it is concluded that: (1) Ionization potential, electron affinity, and work function data which supersede "old handbook" values are available for most common species. The National Bureau of Standards is currently undertaking a critical evaluation of electrical properties and will emphasize substances of interest in chemical propulsion. Electrical properties for several of the polyatomic species and oxides were not found and presumably have not been determined. (2) To make the existing data useful for thermochemical calculations, heat capacity and entropy data for the ions will be required. These data are presently available for only a few of the common ions. (3) Thermochemists seeking to predict electron concentrations are not making use of all the available data, leading to possibly erroneous results. Author

N65-14638 National Bureau of Standards, Washington, D.C.
SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES

Donald D. Wagman *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 13–34 ref (See N65-14636 05-06)

A file of published and some unpublished data relating to heats and free energies of reaction, entropies, and heat capacities of chemical substances is presented. These data will be used in the revision and updating of the NBS circular *Selected Values of Chemical Thermodynamic Properties*. These data serve as the basis for the calculation of a self-consistent set of values for the heats and free energies of formation of pure substances (containing fewer than two carbon atoms) and their aqueous solutions. A table of conversion factors between various units of molecular energy is also presented. D.S.G.

N65-14639 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS

Paul E. Blackburn *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 35–41 refs (See N65-14636 05-06)

Studies on mixed oxides by measuring the pressure as a function of composition at constant temperatures have continued with measurements on the Be–B–O and Al–B–O systems. Because measurements previously reported for the Be–B–O system are now believed to have been diffusion controlled, measurements were made at 1398° K and 1562° K using smaller orifices to suppress diffusion-controlled evaporation. The phase diagram based on these results is discussed, and heats of reaction which were calculated from them are presented. Two measurements were made on the Al–B–O system also; however, smaller orifices again appear to be necessary. Very small orifices, on the other hand, require lengthening experiments from their present time of hundreds of hours to an inordinately long period. D.S.G.

N65-14640 Rice U., Houston, Tex.
RECENT PROGRESS IN FLUORINE CHEMISTRY

John L. Margrave *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 43–50 refs (See N65-14636 05-06)

Mass spectrometric studies on fluorides presented include measurements of sublimation pressures and heats of sublimation for MgF_2, SrF_2, and BaF_2, dissociation energies of alkaline earth monofluorides and mono- and difluorides of silicon and germanium, and heat of atomization of AlF_2. In the study of the kinetics of reactions of elemental fluorine, the rates of fluorination were investigated for silicon, boron, graphite, and TiB_2. The results of a study of the chemistry of silicon difluoride are presented; chemical properties of the gaseous monomer SiF_2 and the polymer $(SiF_2)_n$ are reported. D.S.G.

N65-14641 Little (Arthur D.) Inc., Cambridge, Mass.
RECENT WORK AT ARTHUR D. LITTLE

Alfred Büchler *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 55–66 refs (See N65-14636 05-06)

The present report summarizes work in two areas—the study of the molecular structure of high temperature species by electric deflection and the mass spectrometric study of the lithium fluoride–beryllium fluoride system. The infrared spectrum of beryllium chloride is discussed briefly. Author

N65-14642 National Bureau of Standards, Washington, D.C.
RECENT STUDIES OF THERMODYNAMIC PROPERTIES OF SOME BERYLLIUM AND ALUMINUM SPECIES

Thomas B. Douglas *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 67–72 refs (See N65-14636 05-06)
(ARPA Order 20)

Recent condensed-phase enthalpy data and matrix-isolation spectroscopy on BeF_2, reported by other laboratories, are shown to lead essentially to thermodynamic consistency for the existing vaporization data on BeF_2 and for recent National Bureau of Standards mass-spectrometric data on Be_2OF_2. A current NBS mass-spectrometric investigation of the $BeO\text{-}Al_2O_3$ system has led to preliminary values for the thermodynamic properties of the BeOAl molecule. Author

N65-14643 National Bureau of Standards, Washington, D.C.
CALORIMETRY OF BERYLLIUM COMPOUNDS

George T. Armstrong *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 73–78 refs (See N65-14636 05-06)

The experimental procedure for carrying out combustion studies of beryllium in fluorine in a bomb calorimeter is described. This procedure involves the pelleting of the metal in Teflon powder and the combustion of the combined material in fluorine. The difficulties in determining the amount of reaction due to the incompleteness of combustion are discussed. The results of other studies to determine heats of formation of beryllium fluoride, beryllium chloride, and beryllium nitride are presented. D.S.G.

N65-14644 Aeronutronic, Newport Beach, Calif.
RECENT THERMODYNAMIC STUDIES OF LIGHT-METAL COMPOUNDS

D. L. Hildenbrand *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 79–83 refs (See N65-14636 05-06)

The following is an account of recent experimental studies which bear on the molecular constants and thermodynamic properties of the Group II metal dihalides and on the heat of sublimation of boron. Some modifications which should increase the usefulness of high temperature mass spectrometry are described. Author

N65-14645 Bureau of Mines, Tuscaloosa, Ala. Thermodynamics Lab.
RECENT CALORIMETRIC STUDIES OF BERYLLIUM FLUORIDE
A. R. Taylor, Jr. *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 85–86 (See N65-14636 05-06)

The ice calorimeter enthalpy measurements on alpha quartz type BeF_2 showed a "hump" at the melting point. Petrographic and X-ray examinations of the samples dropped at temperatures above this hump showed that these samples were completely glassy. To make these measurements above the melting point, a correction for the crystal–glassy transformation at 0° C should be applied. This correction was determined recently by solution calorimetry, yielding a net heat effect of 1125 ±16 cal/mole for the reaction:

$$BeF_2(\text{crystalline, } 298° \text{ K}) \rightarrow BeF_2(\text{glassy, } 298° \text{ K}).$$

Heat content measurements performed on a sample of glassy material made by dropping molten quartz type BeF_2 from the calorimeter furnace into the ice calorimeter yielded a net heat effect of 1128 ± 16 cal/mole for the crystalline–glassy transformation at 0° C. D.S.G.

N65-14646 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
THE INFRARED SPECTRA OF MAGNESIUM AND ALUMINUM FLUORIDES BY MATRIX ISOLATION
Milton J. Linevsky *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 87–96 refs (See N65-14636 05-06)

The infrared spectra of MgF_2 and AlF_3 were obtained by matrix isolation. The resulting spectrum for MgF_2 indicates that the molecule is either linear or nearly so (<FMgF = 160° ±20°). The ν_3 and ν_2 have been observed at 843 cm^{-1} and 247 cm^{-1}, respectively, (frequencies for solid argon) for $Mg^{24}F_2$. Using a double-oven technique, the infrared spectrum for AlF_3 was obtained, and the observed frequencies in solid argon were assigned as follows: $\nu_2(A_2'') = 266$ cm^{-1}, $\nu_3(E')$ ~940 cm^{-1} and $\nu_4(E')$ ~251 cm^{-1}. A value for $\nu_1(A_1)$ the inactive fundamental around 646 cm^{-1} can be estimated. Author

N65-14647 IIT Research Inst., Chicago, Ill.
INFRARED SPECTRA BY MATRIX ISOLATION OF SOME LOW-MOLECULAR-WEIGHT INORGANIC HALIDES
Alan Snelson *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 97–104 refs (See N65-14636 05-06)

The infrared spectra of the vapors above beryllium fluoride, beryllium chloride, and magnesium fluoride at elevated temperature have been observed using the matrix isolation technique. New vibrational constants obtained for beryllium and magnesium fluoride are used to derive entropies and free energy functions for these species. The present results suggest the estimated bending frequencies of the beryllium and magnesium halides used in recent thermodynamic compilations are almost certainly in error. Author

N65-14648 Union Carbide Research Inst., Tarrytown, N.Y.
SPECTROSCOPY OF TRANSITION-METAL OXIDES IN NEON AND ARGON MATRICES AT 4° AND 20° K
William Weltner, Jr. *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 105–107 refs (See N65-14636 05-06)

The TaO, TaO_2, HfO, WO, WO_2 and higher oxides of tungsten have been observed spectroscopically in neon and argon matrices. A discussion of TaO and TaO_2 illustrates the information obtained. Author

N65-14649 National Bureau of Standards, Washington, D.C. Molecular Spectroscopy Section
SOME ASPECTS OF HIGH-TEMPERATURE MATRIX-ISOLATION SPECTROSCOPY
D. E. Mann *In* APL Working Group on Thermochem., Proc. of 2d Meeting, Vol. I Aug. 1964 p 109–115 refs (See N65-14636 05-06)

The application of matrix-isolation spectroscopy to high-temperature chemistry was well established. From an experimental standpoint the method is not very difficult and can yield data of considerable value and quality. Its extension to new systems and compounds is limited mainly by the energy, ingenuity, equipment, and level of support available to the investigator. It appears both necessary and likely that within the near future a more extensive effort will be made to observe and measure lower vibrational frequencies than have been previously accessible, and that the low-temperature chemistry of high-temperature systems will receive more intensive study. Author

N65-14660*# Georgia Inst. of Tech., Atlanta.
CHEMICAL REACTIVITY AND SYNTHESIS AT CRYOGENIC TEMPERATURES
Henry A. Mc Gee, Jr. [1963] 24 p refs Presented at the Cryog. Eng. Conf., Boulder, Colo., 19–21 Aug. 1963
(Grant NsG-123-61)
(NASA-CR-51189) OTS: HC $1.00/MF $0.50

Low-temperature chemical synthesis offers promise in the preparation of endothermic molecules, stabilized free radicals, and stabilized excited electronic states or compounds involving electronically excited states. One of the more interesting applications of cryogenic chemistry involves high-energy chemical rocket propulsion. Kinds of experiments which can be accomplished at cryogenic temperatures, such as synthesis of hydrogen superperoxide by the reaction of atomic hydrogen with liquid ozone at 77° K and the synthesis of a series of oxygen fluorides, are discussed. An indication of the types of systems that may result from research in low-temperature chemistry is included. E.E.B.

N65-14672# Iowa State U. of Science and Tech., Ames.
THE CARBON REDUCTION OF URANIUM OXIDE
H. A. Wilhelm Oct. 1964 38 p refs Presented at the ACS 1960 Midwest Award Symp., St. Louis, 12 Nov. 1960
(Contract W-7405-ENG-82)
(IS-1023)

Preparation of uranium by aluminum, magnesium, and calcium metal reduction is reviewed. Of these three metals, calcium is favored and has been employed to obtain large quantities of uranium metal powder by reduction around 1000° C. Massive uranium can then be obtained by powder metallurgy. Two advantages of carbon over magnesium are: (1) The preparation of UF_4 is not required. (2) The amount of carbon required is less than the more costly magnesium. Materials available for the carbon reduction, considerations on the charge of carbon and uranium oxide, equilibrium conditions for the oxygen–carbon reactions, experimental techniques, and results are considered. Photomicrographs of microstructure

of uranium metal in contact with the heating unit, uranium metal retained in the urania crucible, uranium metal prepared in thoria–yttria crucible, and of the low-carbon region in uranium product due to segregation are included. E.E.B.

N65-14705# Bureau of Mines, Norris, Tenn.
SYNTHESIS AND SOME PROPERTIES OF ALUMINUM BORATE WHISKERS
Robert C. Johnson and John K. Alley 1965 27 p refs
(BM-RI-6575)

The primary objective was to grow aluminum borate whiskers or fibers and to determine their properties. Molten salt bath and vapor deposition methods were used for synthesis. Whiskers exceeding 25 mm in length were grown. The best results were obtained by vapor deposition. Three different aluminum borate compositions ($4.8Al_2O_3{\cdot}B_2O_3$, $3.8Al_2O_3{\cdot}B_2O_3$, and $2.5Al_2O_3{\cdot}B_2O_3$) were identified by X-ray and chemical analyses. The aluminum borates $4.8Al_2O_3{\cdot}B_2O_3$ X-ray diffraction pattern was indexed. Optical data were obtained on the three aluminum borates. In addition the following whisker properties and growth factors were determined: ideal atmospheric dewpoint for vapor deposition method, near 65° F; temperature range of whisker formation, 1000° to 1400° C for the molten bath method of synthesis, >1000° to <1400° C for the vapor deposition method; whisker growth rates by the vapor deposition method, maximum 12 mm per hour; raw material vaporization, 50% to 60% of the fluoride lost in 1 hour; tensile strength, maximum obtained 174 162 psi; melting points, ranged from 1675° to 1795° C. Author

N65-14718# Mellon Inst., Pittsburgh, Pa.
[CRYSTALLIZATION AND MECHANICAL PROPERTIES OF POLYMERS. STAR AND COMB TYPE BRANCHED POLYSTYRENES] Technical Report, 1 Mar.–31 Aug. 1964
J. H. Magill et al [1964] 118 p refs
(Contract Nonr-2693(00))
(TR-12; AD-607684) OTS: $4.00

CONTENTS:

STUDIES OF CRYSTALLIZATION IN POLYMERS
1. CRYSTALLIZATION OF POLY-TETRAMETHYL p-SILPHENYLENE SILOXANE POLYMERS J. H. Magill 3 p refs
2. SPHERULITIC CRYSTALLIZATION: PART I "ODD-EVEN" POLYAMIDES: NYLON 5.6 AND NYLON 9.6 J. H. Magill 31 p refs
3. CRYSTALLIZATION OF POLYAMIDES: PT. II: NYLON 6 AND NYLON 66 10 p refs
4. CRYSTALLIZATION AND MORPHOLOGY OF d,l-AND 1-POLYPROPYLENE OXIDE POLYMERS J. H. Magill 12 p refs
5. GLASS TEMPERATURE AND CRYSTAL MODIFICATION OF LINEAR POLYETHYLENE J. H. Magill, S. S. Pollack, and D. P. Wyman 11 p refs

STUDIES OF MECHANICAL PROPERTIES OF POLYMERS
6. CREEP AND RECOVERY PROPERTIES OF A ZINC PHOSPHINATE POLYMER D. J. Plazek 25 p refs
7. INVESTIGATION ON NOVEL INORGANIC POLYMERS H. Nomura and G. C. Berry 2 p
8. VISCOELASTICITY OF CRYSTALLINE POLYMERS M. H. Birnboim, D. J. Plazek, and W. M. Hoffman 5 p

STAR AND COMB TYPE BRANCHED POLYSTYRENES
9. THE PREPARATION AND CHARACTERIZATION OF SOME STAR- AND COMB-TYPE BRANCHED POLYSTYRENES D. P. Wyman, T. Altares, Jr., V. R. Allen, and K. Meyersen 1 p
10. PREPARATION OF MODEL POLYSTYRENES T. Altares, Jr. 4 p

N65-14753# Oak Ridge National Lab., Tenn. Isotopes Div.
VACUUM LEAK TESTING OF RADIOACTIVE SOURCE CAPSULES
C. R. King Jan. 1965 13 p ref
(Contract W-7405-ENG-26)
(ORNL-3664) OTS: $1.00

A procedure was developed for detecting leaks smaller than 0.1μ diam in radioactive source capsules. The capsule is immersed in isopropyl alcohol and a vacuum created above the alcohol to produce bubbling from container leaks. The limit of leak detection over the range studied is dependent on the differential pressure, the surface tension of the liquid, and the leak diameter. Whereas leaks down to 0.7μ diam can be detected by conventional vacuum leak testing without pressurization of the capsule, pressurization to about 125 psig prior to actual testing permits the detection of leaks from openings smaller than 0.1μ diam. This study revealed no limit to the leak-test sensitivity. Author

N65-14755# Société Atome Industriel, Paris (France).
COMPARATIVE BIBLIOGRAPHY OF ACTIVATION ANALYSIS [BIBLIOGRAPHIE COMPAREE DE L'ANALYSE PAR ACTIVATION] Final Report
Brussels, EURATOM, Sep. 1964 546 p refs in FRENCH; ENGLISH summary
(Contract EURATOM-017-62-12 IRAF)
(EUR-1886.f) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 300 Belg. Fr.

The purpose of this work was to present a group of documents, relating to activation analysis, made up of 500 examples of applications chosen for their technical interest. Author

N65-14793# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
PHOTOIONIZATION OF N_2 IN THE 734-805 Å REGION
G. R. Cook and M. Ogawa 20 Nov. 1964 28 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-254; TDR-469(9260-01)-2; AD-609385)

Absolute photoionization coefficients and ionization efficiences of N_2 were measured in the 734 to 805 Å region using a one-meter Seya–Namioka scanning vacuum monochromator with the Hopfield helium continuum as a background light source. The ion-current spectrum obtained was compared with the absorption spectrum observed photographically. Nearly all of the absorption bands with higher energies than the first ionization potential showed ion current peaks, indicating preionization. However, their ionization efficiencies showed strong fluctuations whose magnitudes decreased toward the shorter wavelengths. The spectral regions with the lowest absorption coefficients (180-340 cm^{-1}) beyond the first ionization potential showed the highest efficiencies, the values of which were about 80%. Efficiencies of bands with $m \geq 5$ of the Ogawa–Tanaka Rydberg series were much larger than those of the corresponding bands of the Worley third Rydberg series. The progressions (1) and (2) had a rather high efficiency of 70% which increased slightly with an increase of the vibrational quantum numbers of the upper electronic states. Author

N65-14822# Temple U., Philadelphia, Pa. Research Inst.
PRODUCTION, ISOLATION AND IDENTIFICATION OF THE FO-, FO_2- AND FO_3- RADICALS First Annual Summary Report, Oct. 1, 1963–Sep. 30, 1964
A. D. Kirshenbaum and A. V. Grosse 15 Oct. 1964 40 p refs
(Contract AF 04(611)-9555)
(AFRPL-TR-64-163; AD-609394)

In attempting to produce, isolate, and identify the FO·, FOO· and FOOO· radicals, electron paramagnetic resonance studies of oxygen fluorides and O_2BF_4 were carried out. In addition, the effects of Co^{60} γ-irradiations of O_2F_2, atomic hydrogen bombardment of the fluorides, and ultraviolet irradiation of O_3 and F_2 were investigated. Dioxygen difluoride and O_3F_2 produced the same two E.P.R. signals at 77° K. The triplet state signal was twice as strong in O_3F_2 as in O_2F_2, and the signal that indicated the free radical (FOO·) was 50 to 100 times as strong in O_3F_2 as in O_2F_2. Irradiation of O_2F_2 samples with Co^{60} γ-rays produced a third signal. Oxygen difluoride is diamagnetic while O_4F_2 is highly paramagnetic. The O_2BF_4 molecule is highly paramagnetic and was found to react with atomic H at 77° K to produce ozone. P.V.E.

N65-14825# Naval Research Lab., Washington, D.C. Chemistry Div.
MASS SPECTROMETRIC DETERMINATION OF THE ALIPHATIC AND AROMATIC CONTENT OF A HYDROCARBON MIXTURE Final Report
F. E. Saalfeld 12 Nov. 1964 7 p refs
(NRL-6178; AD-608977) OTS: $0.50

A simplified mass spectrometric technique has been devised for determining the aromatic content in hydrocarbon mixtures of the type that have been recovered from adsorptive carbon samplers exposed in the atmospheres of nuclear submarines. The method is based on the summation of ion currents at mass-to-charge ratios (m/e) of 27, 28, 29, 41, 43, and 57 for aliphatic hydrocarbons and 39, 51, 52, 77, 78, 91, 92, 105, 106, 119, 120, 133, and 134 for aromatic hydrocarbons. The mass spectrometric results agree reasonably well with the fluorescence-indicator-adsorption analyses of the same samples. Author

N65-14835# Alfred U., N.Y. Coll. of Ceramics
USE OF A MASS SPECTROMETER TO STUDY THE HIGH-TEMPERATURE KINETICS OF THE VAPORIZATION OF NON-STOICHIOMETRIC TiO_2 Technical Documentary Report, Aug. 1960–June 1964
Samuel F. Hulbert Wright-Patterson AFB, Ohio. AF Mater Lab., Oct. 1964 177 p refs
(Contract AF 33(616)-7615)
(ML-TDR-64-289; AD-609319)

To demonstrate the feasibility of studying the high-temperature kinetics of vaporization in a solid source (combination surface ionization-electron affinity) mass spectrometer, the kinetics of the vaporization of nonstoichiometric TiO_2 under high vacuum were observed between 1115° K and 2045° K. The reaction was observed in two steps. First, the evolution of oxygen from nonstoichiometric TiO_2 was observed in an electron affinity source as a function of time and temperature. Second, the sublimation of nonstoichiometric TiO_2 (giving $TiO_2(g)$, TiO(g), and Ti(g)) was observed in a surface ionization source as a function of time and temperature. A van't Hoff differential method analysis was performed on the raw data to determine the reaction-rate order. A first-order reaction-rate process was indicated in both cases. Rate constants for both processes, as well as for the overall vaporization of nonstoichiometric TiO_2, were calculated at approximately 50° K intervals between 1115° K and 2045° K. An Arrhenius-type analysis was performed and the activation energies were observed. A thorough investigation was made of the possible systematic and random errors involved in using a solid source mass spectrometer to study the kinetics of high-temperature vaporization. Author

N65-14866# Duke U., Durham, N.C.
ANISOTROPY OF THE CHEMICAL SHIFT OF TRAPPED CHF_3 AND NF_3
A. Brooks Harris, Earle Hunt, and Horst Meyer 10 Oct. 1964 50 p refs
(Contract Nonr-1181(12))
(TR-4; AD-607770)

The values of the anisotropy of the chemical shift tensor obtained were $\sigma_{\parallel} - \sigma_{\perp} = (390 \pm 60)$ ppm for NF_3 and $\sigma_{\parallel} - \sigma_{\perp} = (105 \pm 20)$ ppm for CHF_3, where $\sigma_{\perp}$ is the average of the two components of the chemical shift tensor perpendicular to the fluorine bond direction. For NF_3 a difference of (140 ± 40) ppm between the two perpendicular components was found, indicating a deviation from uniaxial symmetry if the NF bond. The sign and order of magnitude of the chemical shift anisotropy are discussed and can be understood on the basis of current ideas about the relationship between the bond characters and the chemical shift anisotropy. Author

N65-14936# Los Alamos Scientific Lab., N. Mex.
THE X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF MANGANESE IN URANIUM-PLUTONIUM-MANGANESE ALLOYS
E. A. Hakkila, R. G. Hurley, and G. R. Waterbury 24 Dec. 1964 18 p refs
(Contract W-7405-ENG-36)
(LA-3160) OTS: $1.00

Manganese in uranium–plutonium–manganese alloys is determined without chemical separation using an internal standard X-ray fluorescence spectrographic method. The ternary alloy is dissolved in nitric acid, iron is added to serve as the internal standard, and the solution is irradiated using a tungsten-target X-ray tube. The ratios of the intensities of the $K\alpha$ X-ray lines for iron and manganese are measured and compared to ratios measured for solutions of known manganese content. The method is applicable to the determination of 5% to 40% of manganese in the presence of 5% to 50% each of plutonium and uranium with a relative standard deviation in the range between 2 and 0.8%. Because of selective absorption by the M I edge for plutonium, separate calibration curves must be prepared in the presence of greater than 50% of plutonium. Author

N65-14956*# Houston U., Tex.
TRITIUM LOSS AT REDUCED PRESSURES IN A HYDROGEN ATMOSPHERE
G. R. Shoemake [1964] 4 p
(Grant NsG-199)
(NASA-CR-60155) OTS: HC $1.00/MF $0.50

Tritium foils were encapsulated in a glass envelope under a hydrogen atmosphere at various pressures, and tests were made after a month and an additional 3-month period to determine the loss in the ionization current. Results show that the loss of activity from the tritium foils due to reduced pressure and hydrogen encapsulation is not significant. Use of these foils as ionizing radiation sources in space flight applications, particularly the gas chromatographic experiments, presents no problems because a single measurement of ionization current prior to sample analysis will permit correction for losses which might occur during transit time in space. M.G.J.

N65-14970# Joint Publications Research Service, Washington, D.C.
REACTION OF POLYSTYRENE WITH COLLOIDAL LEAD PARTICLES AT THE INSTANT OF THEIR FORMATION AT THE CATHODE
E. M. Natanson and Z. R. Ul'berg 12 Jan. 1965 12 p refs
Transl. into ENGLISH from Ukr. Khim. Zh. (Kiev), v. 30, no. 8, Aug. 1964 p 805–810
(JPRS-28262; TT-65-30121) OTS: $1.00

Conditions for the formation of reaction products in the reaction between macromolecules and lead colloidal particles at the instant of their formation by electrolytic reduction were investigated. Also, the change in viscosity of polystyrene solutions in toluene with addition of lead is reported. It was found that the viscosity decreases with increase in lead. The swelling of products of reaction between polystyrene macromolecules and colloidal lead was also examined. It was found that the presence of lead does not impair the ability of polystyrene to swell. E.E.B.

N65-14984# Idaho U., Moscow.
NEW HYPOFLUORITES CONTAINING NITROGEN
Jean'ne M. Shreeve 1 Oct. 1964 9 p refs
(Contract Nonr-4217(00); ARPA Order 442)
(AR-1; AD-607616)

Attempts to prepare NF_2OF by the fluorination of nitric oxide, the reaction of N_2F_4 + HgO, and the catalytic fluorination of NF_2OSO_2F have been unsuccessful. Some preliminary data on the thermal decomposition of NF_2OSO_2F are included. Catalytic fluorination of trifluoronitrosomethane has yielded $(CF_3)_2NOCF_3$ which has been more completely characterized, and very likely $CF_3(F)NOCF_3$ is also produced. As the other member of this series, NF_2OCF_3 has been prepared and partially characterized. The $(CF_3)_2NOCF_3$ is stable to at least 200° even in the presence of equimolar amounts of elemental fluorine. The thermal decomposition of $CF_3C(O)ONO$ also gives $(CF_3)_2NOCF_3$ in about 5% yields. Author

N65-14990 Brandeis U., Waltham, Mass.
CHARGE DEPENDENCE IN IONIC SOLVATION
Sidney Golden and Charles Guttman 15 Oct. 1964 31 p refs
(Contract Nonr-1677(01))
(TR-12; AD-607805)

Systems consisting of a single electrically neutral or ionic species in interaction with a large number of solvent molecules are treated in general quantum statistical mechanical terms. Such systems are assumed to have Hamiltonians, for each electronic state, which exhibit a dependence upon charge not exceeding quadratic. Changes in the Helmholtz free-energy, energy and entropy functions are determined formally for the process of ionic solvation due to Born. On the basis of a general argument that an electrically neutral species acquires a nonzero potential upon solvation, the changes in the cited thermodynamic functions are shown to be capable of taking on positive values. This behavior is in direct contrast with expectations from the Born expression for such changes. Author

N65-14995# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
IDENTIFICATION AND DETERMINATION OF ETHER-ALCOHOLS IN CARBON REMOVING COMPOUNDS BY GAS CHROMATOGRAPHY
George G. Esposito 8 Sep. 1964 14 p ref
(CCL-166; AD-607454) OTS: $0.50

A combination of programed temperature gas chromatography (PTGC) and ion exchange chromatography are used for the identification and determination of 17 ether–alcohol-type solvents used in low toxicity carbon-removing compounds. A cationic ion exchange column is employed to remove materials that interfere with the gas chromatographic step. An internal standard is added, and the solvents are separated on polyester and Carbowax columns. Author

N65-15020# Union Carbide Research Inst., Tarrytown, N.Y.
MASS SPECTROMETRIC STUDY OF THE OXIDATION OF TUNGSTEN
P. O. Schissel and O. C. Trulson Oct. 1964 24 p refs
(Contract DA-30-069-ORD-2787)
(C-26; AD-450679)

A mass spectrometer has been used to study the kinetics of the oxygen–tungsten reaction over the temperature range 1400° to 3150° K at oxygen pressures as high as 2×10^{-4} torr. The main products of chemical reaction are identified as W_3O_9, W_2O_6, WO_3, and WO_2; their intensities are given as a function of surface temperature and oxygen pressure. At high surface temperatures, atomic oxygen is observed in an abundance comparable to the impingement rate of molecular oxygen on the surface. These observations lead to a reaction mechanism involving two types of oxygen on the surface, the first tightly bound with a desorption energy near 144 kcal/mole, the second more loosely bound with a desorption energy near 114 kcal/mole. A detailed kinetic model is proposed to account for the observations. Author

N65-15021 Rochester U., N.Y.
THE PRIMARY PHOTOCHEMICAL PROCESS IN COMPLEX MOLECULES AND THE REACTIONS OF CERTAIN RADICALS Final Report, Feb. 1, 1963–Aug. 1, 1964
W. Albert Noyes, Jr. 1 Aug. 1964 6 p refs
(Grant AF-AFOSR-206-63)
(AFOSR-64-1688; AD-606075)

A brief description and summary of the work performed is presented. The work was divided into the following studies: (1) behavior of excited singlet and triplet states of benzene—comparison of the emission of light (C_6H_6) and heavy (C_6D_6) benzene; (2) reactions of the triplet states of biacetyl; and (3) photochemistry of molecules including reactions of radicals—methyl isopropyl ketone (3-methyl 2-pentanone), 2-butanone, methyl radicals, and isopropyl radicals. P.V.E.

N65-15022# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
PROGRESS IN ACTINIDE ELEMENT CHEMISTRY: A SUMMARY OF HANFORD LABORATORIES ACHIEVEMENTS IN THESE PROGRAMS UNDER GENERAL ELECTRIC 1956–1964
L. L. Burger Nov. 1964 18 p refs
(Contract AT(45-1)-1350)
(HW-83611) OTS: $1.00

The actinide-element-chemistry research program evolved from the need for improvement of existing processes and for new separations technology for uranium and plutonium. Work was done in the development and testing of solvents for the extraction of inorganic compounds including mechanism of transfer across liquid–liquid interfaces and associated liquid surface phenomena, the behavior of actinides and fission products in solvent extraction systems and their basic chemistry, the use of and characterization of ion exchange materials, and the identification and properties of molecular species that exist in process systems. A list of papers that have resulted from the research is included. P.V.E.

N65-15032 Texas U., Austin.
A SPECTROPHOTOMETRIC ANALYSIS OF PROCYON Final Report
Frank N. Edmonds, Jr. Oct. 1964 4 p
(Grant Nonr-00063-62)
(AD-607453)

The equivalent width of 152 spectral lines (most of them weak) and the profile of the three strong lines were measured from 19 high-dispersion spectrograms. Included are lines of 22 chemical elements, 8 of which have lines in two stages of ionization. Photoelectric spectral scans of the continuous spectrum were reduced and combined to give an observed continuous spectrum curve for Procyon, using the straight-line extrapolation method. Methods for analyzing the equivalent widths of weak lines toward determining chemical abundance were investigated. Essentially negative results were obtained from a study of the possible use of non-LTE (non-local thermodynamic equilibrium) techniques in the analysis of the Procyon spectra. M.G.J.

N65-15050# Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center

HEATS OF FORMATION OF LITHIUM CHLORIDE AND LITHIUM OXALATE, INCLUDING DETAILS ON THE CONSTRUCTION AND OPERATION OF A SOLUTION CALORIMETER

B. B. Letson and A. R. Taylor, Jr. 1965 16 p refs
(BM-RI-6583)

The heats of formation of lithium chloride and lithium oxalate were determined with the aid of a glass Dewar-type solution calorimeter which uses thermistors as its temperature sensing element. Values obtained at 298.15° K were −98.38 ±0.54 kcal/mole for lithium chloride and −329.02 ±0.79 kcal/mole for lithium oxalate, using graphite as the standard state for carbon. Author

N65-15071# European Atomic Energy Community, Brussels (Belgium).

OSCILLOGRAPHIC POLAROGRAPHY IN MOLTEN NITRATES. I: THE VALIDITY OF THE RANDLES-SEVCIK EQUATION

M. Francini and Silvana Martini Aug. 1964 56 p refs Presented at 19th Intern. Congr. of Pure and Appl. Chem., London, 10–17 Jul. 1963
(EUR-1908.E) Available from Belg. Am. Bank and Trust Co. N.Y., Account No. 22.186: 85 Belg. Fr.

The polarographic investigation of Pb, Cd, Tl, Ni, Zn nitrates in a KNO_3-$LiNO_3$-$NaNO_3$ molten eutectic mixture was carried out by conventional and oscillographic (single-sweep) polarography. Experiments were carried out in the temperature range 140° to 200° C, with the dropping mercury electrode as the cathode and a large Pt foil or an Ag/AgCl reference electrode acting as anodes. For reversible electrode reactions (Cd, Pb, Tl) the polarographic diffusion coefficients calculated from conventional polarography data by the Ilkovic equation agree within experimental error with those obtained from oscillographic data by the Randles–Sevcik equation at low potential change rates. At higher potential change rates, deviation of the experimental value of the peak currents from the theoretical ones was observed. This is associated with a marked distortion of the wave and indicates a certain degree of irreversibility of the electrode reaction. Author

N65-15094# Southwest Research Inst., San Antonio, Tex.

MIXED ACIDS ANALYSIS BY NUCLEAR SPIN RESONANCE (NSR) Final Report

William H. Storey, Jr. 18 Aug. 1964 77 p refs
(Contract DA-23-072-AMC-45(A))
(AD-606775)

The feasibility of using nuclear spin resonance (NSR) for the on-stream analysis of mixed nitrating acids is demonstrated. In the proposed method, the oxides are determined separately by colorimetry. A stream of mixed nitrating acids is passed through the instrument. A centrifugal separator first removes suspended matter, except for colloidal particles, to minimize the line widths of the NSR signals and to increase the accuracy of colorimetric oxide determination. The stream then passes through a temperature controller before being divided such that a small part goes to the colorimeter for oxides measurement and the remainder passes into the magnet for NSR analysis. Measurements of proton chemical shift and of nitrogen-14 signal intensity are made. These signals and those from the oxide measurements are fed to a computer. Computer operations yield the nitric acid concentration and the Q value, the latter being the sum of the concentration of water and two-tenths of the concentration of oxides. Automatic process control can then be based upon differential digital data from the computer. R.L.K.

N65-15118# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

THERMOGRAVIMETRIC STUDY OF ORTHOBORIC ACID, H_3BO_3. I: DEHYDRATION AS INFLUENCED BY THE FOLLOWING FACTORS: RATE OF HEATING; DEGREE OF FINENESS AND THICKNESS OF SUBSTANCE; DRY OR HUMID GAS ATMOSPHERE

Jean Haladjian and Georges Carpéni Dec. 1964 15 p Transl. into ENGLISH from Bull. Soc. Chim. France (Paris), 1956 p 1679–1682
(RSIC-334; AD-609162)

The general form of the registered curves depends largely on the dehydration factors. Whereas, normally, only three plateaus corresponding to the definite substances H_3BO_3, HBO_2 and B_2O_3 ought to be noted, in reality three types of anomalies are observed: (1) the plateau, still characteristic of the acid HBO_2, which is sometimes completely absent; (2) distant plateaus at different levels, indicating the formation of manifestly nonstoichiometric compounds; and (3) points of angular inflection sometimes appearing between the H_3BO_3 and HBO_2 levels. Author

N65-15119# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

STUDIES ON THE ISOHYDRIC POINT. (XIX): THE HYDRATED GERMANIUM OXIDES $GeO_2 \cdot xH_2O \cdot aq$. (PREPARATION, THERMOGRAVIMETRY, X-RAYS)

A. Pietri, J. Haladjian, G. Périnet, and G. Carpéni Dec. 1964 20 p refs Transl. into ENGLISH from Bull. Soc. Chim. France (Paris), 1960 p 1909–1914
(RSIC-335; AD-609163)

The study, performed by means of thermobalance and X-rays, shows that in different samples, although the hexagonal crystal lattice of the so-called "soluble" form of GeO_2 remains the same at all temperatures, the water of hydration may be clearly classified into two distinct categories: (1) Weakly bound and reversible—This water leaves the oxide at low temperatures ($t \lesssim 100°$ to 120° C) and may be legitimately considered as being simply adsorbed (or absorbed). (2) Firmly bound and irreversible—This can, at the maximum, amount to about 3.4% of the anhydrous product, and necessitates, for its removal, relatively high temperatures ($t \gtrsim 200°$ to 220° C). The analyzed samples seem to be mixtures of the anhydrous oxide GeO_2 and the "hydrate" 5 $GeO_2 \cdot H_2O$, in variable proportions, and with the adsorbed water (aq.) yield the overall formula: $GeO_2 \cdot xH_2O \cdot aq.$ ($x \leq 0.2$). Author

N65-15134 Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.

SPECIFIC CONDUCTANCE, pH, DENSITY, AND VISCOSITY OF SODIUM ALUMINATE SOLUTIONS AND SOME PROPERTIES OF THE ALUMINATE ION

R. V. Lundquist 1965 15 p refs
(BM-RI-6582)

The specific conductance of solutions of sodium hydroxide and of sodium aluminate was directly proportional to the temperature. The specific conductance of sodium aluminate solutions with identical sodium-ion concentration and at constant temperature decreased with increase in aluminum concentration. The aluminate-ion population in solution was shown to consist of a mixture of monovalent and polyvalent ions. Aluminate ions did not influence the temperature dependence of pH in caustic solutions containing sodium aluminate. The density and viscosity of a solution was inversely proportional to the temperature and directly proportional to the concentrations of sodium and aluminate ions. Author

N65-15158*# National Aeronautics and Space Administration, Washington, D.C.
A STUDY OF THE RADICAL FORM OF ADSORPTION OF MOLECULAR OXYGEN BY REDUCED TITANIUM DIOXIDE USING THE ELECTRON PARAMAGNETIC RESONANCE (EPR) METHOD [IZUCHENIYE METODOM E.P.R. RADIKAL'NOY FORMY ADSORBTSII MOLEKULYARNOGO KISLORODA NA VOSSTANOVLENNOY DVUOKISI TITANA]
V. B. Kazanskiy, O. V. Nikitina, G. B. Pariyskiy, and V. F. Kiselev Jan. 1965 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 2, 1963 p 369–372
(NASA-TT-F-9235) OTS: HC $1.00/MF $0.50

A study is made of the electron paramagnetic resonance spectra of oxygen chemisorbed by partially reduced titanium dioxide. An anatase preparation is used for the experiment. The data obtained provide only rough estimates. The intensity of the EPR signals is similar to the amount of adsorbed oxygen molecules. Author

N65-15208# Defence Chemical Biological and Radiation Labs., Ottawa (Canada).
THE DIFFUSION OF WATER VAPOUR THROUGH QUARTZ
G. L. Christie Jul. 1964 30 p refs
(DCBRL-TN-64-7)

A furnace assembly and gas analytical train intended for the analysis of magnesium metal for hydrogen, incorporated the fractionation of hydrogen from other gases by copper oxide oxidation and low temperature trapping. When the furnace was operated under blank conditions large volumes of hydrogen were detected. The source was found to be the migration of water vapor through the quartz furnace tube. At 700° C a rate of one to two microlitres per hour was measured, at 1000° C the rate was 25 to 65 microlitres per hour. Author

N65-15228*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRAGMENTATION OF ANTHRACENE IN AN ELECTRON-BOMBARDMENT ION SOURCE
Nelson L. Milder Washington, NASA, Jan. 1965 17 p refs
(NASA-TN-D-2592) OTS: HC $1.00/MF $0.50

Fragmentation of anthracene in a 5-cm-diam version of a Lewis electron-bombardment ion source was studied with the aid of an electric quadrupole mass spectrometer. Seven to nine peaks of comparable intensity were observed corrresponding to specific masses ranging from about 20 to 178 amu per unit charge. The variation in relative peak heights as a function of electron emission current and ion discharge voltage is presented. Emission currents ranged from 40 to 140 V. The experiment demonstrated that severe fragmentation of anthracene occurs even under minimum conditions of sustained ion discharge. Author

N65-15232# Michigan U., Ann Arbor.
THE BEHAVIOR OF DYNAMIC ELECTRIC ARCS Interim Technical Documentary Report, 1 Oct. 1963–15 Jul. 1964
R. L. Phillips Wright-Patterson AFB, Ohio, ARL Sep. 1964 181 p refs
(Contract AF 33(615)-1326)
(ARL-64-150; AD-609956)

The thermal structure of an ac arc was studied both experimentally and analytically. In the general case, the problem was solved on a digital computer. In all cases, a simplified relationship between the electrical conductivity and the plasma temperature was assumed. The theoretically derived waveforms for electric-field strength and current bear a close relationship to those found by experiment. The latter results were obtained from a cascade-tube arc such as that employed by Maecker for his dc work. The present device was excited by 60-cps ac power, and rms currents up to 30 A were employed. Nitrogen and argon were the working gases. Author

N65-15250# Parametrics, Inc., Waltham, Mass.
CHEMICAL-ELECTRICAL SENSING
C. Levy, O. Cucchiara, and D. Chleck Griffiss AFB, N.Y., RADC, Dec. 1964 29 p refs
(Contract AF 30(602)-3305)
(RADC-TDR-64-388; AD-609721)

An investigation was conducted to determine the feasibility of using krypton-85 homologs to detect trace quantities of hydrogen chloride and hydrogen fluoride in air. Zinc foil kryptonates were found to respond well to low hydrogen chloride concentrations and thus can serve as detectors. Calibration curves are presented for the range of hydrogen chloride concentrations from 97 ppb to 250 ppm for exposure times up to 3 hours. Relative humidity had no significant effect on the detection sensitivity. Aluminum and copper kryptonates showed satisfactory response to a hydrogen fluoride concentration of 263 ppm. A flow system for obtaining lower concentrations has been constructed. Author

N65-15260# Georgia U., Athens.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Research Report for 1964
W. C. Sears 18 Dec. 1964 34 p refs
(Contract AT(40-1)-2418)

Organic polymers were irradiated in vacuum with gamma rays from Co^{60} as part of an investigation of the changes in molecular structure produced by high-energy radiation. These structural changes were determined by measuring the infrared spectra of polymer films before and after irradiation. In a study of the methyl group role in transvinylene growth in irradiated polyethylene, the postulate that growth of transvinylene unsaturation is accompanied by loss of methyl groups was disproved. Other polyethylene studies concern dose rate and storage time, oxidation, crystallinity, light scattering, and transvinylene concentrations. Methods of preparation of uncured and unstretched films of Neoprene types W, GN-M2, and CG for infrared spectra and irradiation were developed, and the obtained results are described. R.L.K.

N65-15374*# Detroit U., Mich.
PROBABLE SYNTHESIS OF PORPHINE-LIKE SUBSTANCES DURING CHEMICAL EVOLUTION
Anton Szutka [1963] 18 p refs Presented at the Conf. on the Origin of Prebiol. Systems, Wakula Springs, Fla., 27–30 Oct. 1963
(Grant NsG-226-62)
(NASA-CR-52450) OTS: HC $1.00/MF $0.50

This study shows that porphine-like structures can be synthesized in the presence of oxygen from precursors which were available in the very earliest stage of chemical evolution. These precursors are aldehydes, pyrrolidines, and pyrrole. It is indicated that the change of a reductive atmosphere to an oxidative one due to the photolysis of water, which produced H_2O_2, created an immediate need for the formation of porphine-like substances. I.v.L.

N65-15385# Defence Standards Labs., Maribyrnong (Australia).
THE PREPARATION OF ORGANOTIN COMPOUNDS
P. Dunn and T. Norris Feb. 1964 24 p refs
(Rept.-269)

Methods of synthesis and analysis are detailed for various organotin carboxylates, oxides and hydroxides, hydrides, and halides. Percentage yield, melting point, boiling point, index of refraction, and tin content are tabulated for compounds in the same groups as above. D.E.W.

N65-15386# Aeronautical Research Labs., Melbourne (Australia).
A COMPOSITE SCHEME FOR THE ANALYSIS OF ALUMINIUM ALLOYS BY ATOMIC ABSORPTION SPECTROSCOPY
L. Wilson Jan. 1964 20 p refs
(ARL/MET-52)

Atomic absorption spectroscopy has been applied to the determination of copper, zinc, magnesium, and silver in aluminium alloys. Only one sample weighing is necessary, and results can be obtained within 1 or 2 hours. The developed procedure gave results which compared well with those obtained by classical methods of analysis. Author

N65-15387# Köln U. (W. Germany). Institut für Medizinische Isotopenforschung
STUDY OF THE STABILITY OF TRITIUM LABELLED AMINO ACIDS OF HIGH SPECIFIC ACTIVITY [UNTERSUCHUNGEN UBER DIE LAGERFAHIGKEIT H-3-MARKIERTER AMINOSAUREN HOHER SPEZIFISCHER AKTIVITAT]
W. Nouvertne and K. Hempel Brussels, EURATOM, 1964 19 p In GERMAN; ENGLISH summary
(Contract EURATOM-016-62-2 RISD)
(EUR-1828.d) Available from Belgian Am. Bank and Trust Co., N.Y. Account No. 22.186: 40 Belg. Fr.

Phenylalanine-(2,4-T_2), lysine (γ, δ-T_2), and 3,4-dihydroxyphenylalanine-(2,5,6,-T_3) of high specific activity (8000 mC/m Mol and more) were stored in solute (solvent: 80% ethanol or water) and in solid form under 10 different conditions. The radiochemical purity of the amino acids was investigated by paper chromatography after varying storage time. Maximum stability was shown by tritiated amino acids in ethanol solution at low temperature. Under these conditions, tritiated phenylalanine and lysine could be stored up to 6 months without developing more than one percent tritiated impurities. Author

N65-15395# Monsanto Research Corp., Everett, Mass. Boston Lab.
CHEMILUMINESCENT SYSTEMS Technical Report No. 1
13 Oct. 1964 26 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009Q1; AD-607201)

The objective was to design and procure the photometric instrumentation, and to investigate empirically the response of typical known chemiluminescent reactions to solvent variation, catalysis, and, to a lesser extent, the addition of sensitizers. Representative bright and feeble chemiluminescent reactions were chosen. The major effort in the first class was devoted to the oxidation of lucigenin. As a result of checks for background radiation, it was confirmed that the observations of Vassil'ev and Stauff of widespread feeble chemiluminescence accompanying oxidation reactions applied to many presumably quite pure organic solvents. It was found that Vassil'ev's and Chandross' observations of sensitized increase of emission of many orders of magnitude apply to one system investigated (acetone). Tetrahydrofuran (THF) is a more efficient catalyst for lucigenin chemiluminescence than previously investigated organic substances. Furthermore, the chemiluminescent decomposition of alkaline peroxide in the presence of THF is extraordinarily bright, being readily visible to the eye, in the absence of sensitizers. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-14480# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADIO PHYSICS Quarterly Progress Report, Division 6, 1 Aug.–31 Oct. 1964
J. W. Meyer and M. A. Herlin 15 Nov. 1964 13 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-576; AD-609014)

At the Millstone radar complex, emphasis on space surveillance techniques is being increased as planetary observations taper off; at the Haystack Experimental Facility, emphasis is on completion of the facility and program planning. Space surveillance activities included modification of the electronic-systems precision orbit-determination (ESPOD) computer program for the IBM 7094, and tracking of 19 satellites of the difficult class. Radar and radioastronomy activities included radar measurements indicating that the surface of Venus is considerably smoother than that of the Moon, and calibration of radiometers installed on the Haystack antenna. Ionospheric and auroral observations were continued, and the results for the case where only O^+ ions are present are being analyzed. Propagation activities included analysis of radar backscatter from atmospheric phenomena obtained from uhf, S-, and X-band radars at Wallops Island, Va., and preliminary evaluation of methods of obtaining a simple statistical model of severe rainfall attenuation at X-band for Earth–space communication paths for the New England climate. M.P.G.

N65-14481# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HIGH-TEMPERATURE ANTENNA INVESTIGATION Interim Engineering Report, Quarter Ending 30 Sep. 1964
G. F. Buranich [1964] 32 p ref
(Contract AF 33(657)-11100)
(IER-6; AD-607615)

Experimental effort continued on high temperature models of waveguide slot, annular slot, and printed spiral antennas. Two separate alumina windows sealed across the open end of a columbium S-band waveguide developed cracks after cooling. The nominally matched thermal coefficients of expansion

of these materials are not exact enough to prevent fracture of thin alumina windows. An annular slot antenna assembly employing a corrugated metal disk–alumina window was electrically matched. Fused silica and alumina substrates and fired-on platinum conductors have been used in high temperature spiral antenna assemblies. The low loss of these substrates produces rapidly fluctating VSWR values (with frequency), and the high dielectric constant of the alumina causes an apparent narrowing of antenna bandwidth. Author

N65-14487 Spacelabs, Inc., Van Nuys, Calif.
DYNAMIC MEASUREMENTS OF PROTECTIVE MASKS Final Report
Robert N. Sato 5 Dec. 1964 66 p
(Contract DA-18-108-AMC-228(A))
(AD-609582)

Engineering specifications for the circuitry and test procedures to evaluate a detection and measurement system for pressure and flow conditions within a protective mask are described. Designed for use by test subjects at remote locations, measurements of compartment pressure and respiratory flow are converted to an electrical signal and conveyed by FM transmission to the ground receiving station for immediate readout or storage in a memory device. The complete system consists of the following: (1) a gas mask with electronics module; (2) a back pack with an FM transmitter and batteries for power supply; (3) two consoles, including discriminators, FM receivers, and oscillograph and tape recorders, for the ground station; and (4) a transducer, a pneumotachometer, and battery charging cable for the system. M.G.J.

N65-14496# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
LEAST MEAN SQUARE ERROR ANALYSIS OF PCM TRANSMISSION Physical Sciences Research Paper No. 62
Ian T. Young Oct. 1964 21 p refs
(AFCRL-64-864; AD-608782)

Optimal energy distribution applied to a least mean square error criterion for PCM transmission is discussed. Comparisons are drawn between the optimized scheme and the standard scheme for (1) white noise channel, and (2) white noise and Rayleigh fading channel. It is concluded that for few bit samples only small energy savings are attained. Author

N65-14540*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR COMMUNICATIONS
Eberhardt Rechtin 28 Jun. 1963 43 p refs
(Contract NAS7-100)
(NASA-CR-60049; JPL-TR-33-133) OTS: HC $2.00/MF $0.50

Lunar communication is treated as a problem in physics and practical engineering. Examples are given of communication designs to and from the earth from both the near and far sides of the moon and of communications from one point on the moon's surface to another. The choice of modulation system is shown to depend on the signal-to-noise ratio in a 1-cycle band, the threshold characteristics of the receivers, and the allowable radiofrequency bandwidth. A brief comparison between radio and optical communications shows that radio is more advantageous at present. Author

N65-14550# Pan American World Airways, Inc., Patrick AFB, Fla. Guided Missile Range Div.
THE UDOP HANDBOOK
Daniel L. Schneid Patrick AFB, Fla., AF Eastern Test Range, Jul. 1964 212 p refs
(Contract AF 08(606)-5300)
(AFETR-TR-64-7; AD-609038)

This document contains a complete description of the UDOP (ultrahigh frequency doppler) System used on the Atlantic Missile Range. All phases of the effort involved when UDOP is called up to support a mission are included. This document explains the theory, equipment solution, and mathematical techniques involved. Author

N65-14571# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DETECTION OF THE ENERGY PEAK OF AN ARBITRARY SIGNAL Technical Report No. 325
L. Kleinrock 23 Aug. 1963 31 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-588; AD-425894)

A new procedure is described for determining the frequency at which the power spectrum of a signal has its absolute peak. The salient feature of the procedure is that it does not explicitly involve the estimation of the power spectrum of the signal itself. Specifically, it is shown that the limit of the iterated normalized autocorrelation of a function f(t) is a pure cosine wave whose frequency corresponds to the location of the maximum energy density in the spectrum of f(t). Furthermore, if the frequency of maximum energy is acceptable to within a given finite spectral resolution, then the procedure terminates after a specified finite number of iterations. Results from a computer simulation of the procedure are also described. Author

N65-14588# Illinois U., Urbana. Radiolocation Research Lab.
A WIDEBAND VERTICAL INCIDENCE RADIO LOCATION ARRAY Technical Report No. 7
Fred Ore Sep. 1964 60 p refs
(Contracts Nobsr-85243; Nobsr-89229)
(RRL-259; AD-607887) OTS: $3.00

The feasibility of designing a wideband, high-efficiency vertical incidence antenna capable of providing either a single or split beam centered on the zenith has been investigated by the use of scale models. It was found that two log-periodic dipole array elements arranged in an H-plane array fed properly over ground would provide the required beam configuration in the H-plane. A performance investigation as a function of the various design parameters was conducted where the design parameters' variation was limited to some extent by the practical considerations involved in an antenna designed for the 2 to 32 Mc frequency range. It was found that there existed a combination of parameters which would provide a reasonably good compromise between ideal pattern and impedance performance, the impedance performance being the more critical of the two. Author

N65-14603*# Consultants and Designers, Inc., Arlington, Va.
ON THE QUESTION OF PROPAGATION OF ELECTROMAGNETIC WAVES BETWEEN THE EARTH AND THE IONOSPHERE [K VOPROSU O RASPROSTRANENII VOLN MEZHDU ZEMLEY I IONOSFEROY]
B. Z. Katsenelenbaum 1 Dec. 1964 9 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), no. 10, 1964 p 1875–1877
(Contract NAS5-3760)
(NASA-TT-F-8995; ST-AI-RWP-10243) OTS: HC $1.00/MF $0.50

Waveguide propagation in the earth–ionosphere region can be considered a consecutive reflection of Brillouin waves from both the earth and ionosphere, with the angle of incidence linked with the wave propagation constant in the waveguide. Assuming that the propagation factor is dependent upon the reflection factor, simultaneous determination of two mutually

dependent quantities—the angle of incidence on the ionosphere and the reflection from it—is necessary for obtaining the propagation constant. Avoiding the Brillouin wave factor, simplified formulas were worked out, with the electric field assumed to be zero on the earth's surface. Generalized mathematical apparatus were used for impedance boundary conditions. M.G.J.

N65-14615*# Consultants and Designers, Inc., Arlington, Va.
MEAN RADIATION PATTERN OF AN EMITTER IN A TURBULENT ATMOSPHERE [O SREDNEY DIAGRAMME NAPRAVLENNOSTI IZLUCHATELYA V TURBULENTNOY ATMOSFERE]
N. G. Denisov and Yu. A. Ryzhov 22 Dec. 1964 8 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 11, 1964 p 1944–1947
(Contract NAS5-3760)
(NASA-TT-F-9615; ST-RWP-05-10264) OTS: HC $1.00/MF $0.50

The effect of turbulent inhomogeneities of the atmosphere on the mean radiation pattern of the emitter is investigated. With the help of the reciprocity theorem, this problem is reduced to the calculation of the mean intensity in the focus of the lens as a function of the angular position of the source, whose emission passes through the turbulent layer situated in front of the lens. The results of computations of the mean radiation pattern are brought out for various values of the standard deflection ratio of the angles of incidence to the angular dimensions of the radiation pattern of the emitter. Author

N65-14664# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
CONCERNING THE THEORY OF RADIATION FROM A SLOTTED CONDUCTING PLANE IN A PLASMA ENVIRONMENT
James R. Wait 28 Sep. 1964 19 p refs
(NBS-TN-223) GPO: $0.20

A preliminary analysis is given for the radiation into a plasma half-space from an infinitely long slot in a perfectly conducting ground plane. The plasma is anisotropic by virtue of a dc magnetic field which is parallel to the slot. For a homogeneous plasma, it is found that for such a configuration the radiation pattern will be symmetrical, but the excited surface wave is highly asymmetrical. The extension of the theory to an inhomogeneous magnetoplasma is outlined briefly. Author

N65-14669# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE LINCOLN EXPERIMENTAL TERMINAL SIGNAL PROCESSING SYSTEM Group Report 1964–54
P. R. Drouilhet, Jr. and I. L. Lebow 16 Oct. 1964 19 p
(Contract AF 19(628-500)
(ESD-TDR-64-562; AD-450689)

The design of the experimental terminal includes a digital signal processing system which is compatible with both dispersive and nondispersive satellite communications media. It provides three data rates: 9600 bits/sec, to accommodate a voice-excited vocoder with telephone quality inputs; 4800 bits/sec, to accommodate a pitch-excited vocoder with dynamic microphone input; and 200 bits/sec for teletype only. Both of the speech rates allow two multiplexed teletype channels. The basic modulation system combines frequency-hopped signals with sequential encoding and decoding. Antenna pointing, range and doppler predictions, and data multiplexing and demultiplexing are performed using a Univac 1218 digital computer. Author

N65-14677# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
DEVELOPMENT OF A FOAM/FIBERGLAS, VHF (50-500 Mc), DOUBLY RIDGED, LENS-CORRECTED HORN ANTENNA
Peter Koert, Jr., Richard F. Huelskamp, and Donald L. Anderson 1 Jul. 1964 52 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-N667; AD-450180)

This report describes the design, development, fabrication, and electrical performance of a lens-corrected, doubly ridged vhf horn (50 to 500 Mc). The horn was constructed from Fiberglas-reinforced plastics and polyurethane foam. The double-convex circular lens was constructed from building blocks of nesting polyurethane-foam modules. A metal film was deposited on the horn and lens by means of a flame-spraying technique. Author

N65-14698# Illinois U., Urbana. Radiolocation Research Lab.
ANTENNA ARRAY EVALUATION SYSTEM Technical Report No. 9
Edward W. Ernst, William C. Mc Clurg, and Leon J. Miller Sep. 1964 89 p refs
(Contract NObsr-89229)
(RRL-261; AD-607509) OTS: $4.00

New techniques and equipment for evaluating the characteristics of a multielement antenna array over wide frequencies (2 to 32 mcps) have been devised. To determine the pattern of an individual element, the antennas are connected sequentially to a receiver while the source remains fixed, giving the effect of rotating the array. This sequential connection is accomplished rapidly so that the source and other potential variables can be maintained essentially constant during a single rotation. However, rather than use a rotating system such as a goniometer, a discrete switching system has been devised. To permit high-speed switching, electronic commutation techniques employing semiconductor diodes are used. The signals to drive the diode switches are, in turn, derived from semiconductor digital logic circuits. This permits considerable flexibility of test system operation without excessive complexity. M.G.J.

N65-14720# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SPACE COMMUNICATIONS Quarterly Progress Report, Division 6, 1 Jun.–31 Aug. 1964
G. P. Dinneen and W. E. Morrow, Jr. 20 Oct. 1964 31 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-376; AD-450448)

Contributions to the space communications program are reported for the following divisions: (1) the RF Components Group, which conducts studies on switched-beam antenna systems, telemetry antenna, the West Ford Tracking system, the Lincoln Experimental Terminal (LET), and other subjects; (2) the Surface Techniques and Equipment Group, which is principally concerned with the LET; (3) the Space Techniques and Equipment Group, whose efforts are concentrated on environmental studies, space experiments and instrumentation, and orbital physics; (4) the Analysis Group, in which communication theory, multiple access studies, noise theory, coding theory, queuing theory, and other topics are studied; (5) the Radio Physics Division, which is concerned with the Haystack Project; (6) the Radar Division; and (7) the Engineering Division. D.S.G.

N65-14757 General Bronze Corp., Garden City, N.Y.
DEVELOPMENTAL PROGRAM FOR THE FABRICATION AND TESTING OF LIGHTWEIGHT WAVEGUIDE, PHASE II Interim Engineering Report 8 May–7 Aug. 1964
G. Doundoulakis, F. Barth, and J. Millery [1964] 17 p
(Contract NObsr-85320)
(AD-603771)

Engineering development, design, and preliminary determination of the electrical length required for each serpentine convolution in a 96-in. lightweight serpentine waveguide structure were studied. Mechanical mockups, spacers, dipoles, and probes were manufactured to accomplish this engineering effort. On the basis of a theoretical analysis of the waveguide antenna, mockups were designed and fabricated to test the results. An adjustable dipole and an adjustable waveguide convolution were also designed and fabricated. M.G.J.

N65-14759# RCA Victor Co., Ltd., Montreal (Canada). Research Labs.
A SURVEY OF GEODESIC LENS SCANNING ANTENNAS
G. E. Roberts and H. Kaufman Oct. 1963 99 p refs Work Performed under Subcontract for Northern Elec. Co.
(Contract DDP-9-PC1-436)
(Rept.-6.501.2; AD-424354) OTS: $8.60

This report deals with a survey of a class of scanning antennas of the parallel-plate, surface-of-revolution type. This type of antenna is capable of scanning through sectors of wide angles or even a complete 360° without deterioration in performance due to scanning. Author

N65-14774 Joint Publications Research Service, Washington, D.C.
OPTIMAL DISTRIBUTION OF THE LIMITED MEANS FOR CONVEX-CONCAVE PAYOFF FUNCTION
I. N. Kuznetsov *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 142–152 refs (See N65-14762 05-10) OTS: $6.00

Conditions are found, the fulfillment of which ensures optimal distribution $\phi(x)$ of limited means ϕ with respect to the space X. Since that distribution is considered optimal it ensures the largest value of the average payoff. The investigation is done for a known a priori probability $p(x)dx$ of obtaining a payoff $P(\phi,x)$ where the payoff function $P(\phi,x)$ has the interval $(0,\phi_1)$ of convexity below and the interval (ϕ_1,∞) of convexity above. Author

N65-14796# RAND Corp., Santa Monica, Calif.
A TWO-STEP SEQUENTIAL PROCEDURE FOR IMPROVING THE CUMULATIVE PROBABILITY OF DETECTION IN RADARS
L. E. Brennan and F. S. Hill, Jr. Oct. 1964 71 p refs
(Contract AF 49(638)-700)
(RM-4338-PR; AD-609426)

A simple two-step search procedure for phased-array radars is described. The first step considers a detection scheme for five target scintillation models; the single scan detection probability (blip/scan ratio) is plotted and compared with the conventional single-pulse detection probability. The second step extends the detection method to the computation of cumulative detection probabilities that an approaching target will be detected at least once by the time it reaches a given range. Results indicate that the second pulse should be transmitted immediately after the first. This would be expected since first pulse detection implies a favorable echo area. Cumulative detection probability may be possible by varying the second-pulse energy and the thresholds as a function of range. R.W.H.

N65-14806*# Jet Propusion Lab., Calif. Inst. of Tech., Pasadena.
POWER LOSS BETWEEN ARBITRARILY POLARIZED ANTENNAS
R. W. Hartop 1 Sep. 1964 15 p refs
(Contract NAS7-100)
(NASA-CR-60124; JPL-TR-32-457) OTS: HC $1.00/MF $0.50

The general equation for the loss of signal because of polarization mismatching is derived from fundamentals. Useful approximation formulas, as well as equations covering special cases, are presented in tabular and graphic form. Author

N65-14810# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
DISTORTION INTRODUCED INTO FREQUENCY MODULATION BY ARBITRARILY LIMITING THE TRANSMISSION BANDWIDTH
Robert Leroy Burt and Adolph William Foeh (M.S. Thesis) Aug. 1964 216 p refs
(GE/EE/64-2; AD-607535) OTS: $6.00

The distortion introduced by arbitrarily limiting the transmission bandwidth of an FM wave can be obtained by solving the mathematical expression derived, verified, and illustrated in this thesis. Although the method explained will determine distortion of an FM wave modulated by the sum of any number of sinusoidal signals, the digital computer solution time becomes excessive when more than 10 modulating signals are applied. Solutions graphically illustrated include modulating signals of (1) single sinusoids with modulating indices varying from 0.3 to 50.0; (2) two through six nonharmonic sinusoids; and (3) triangular pulse represented by the first six terms of its Fourier series. Author

N65-14904 Joint Publications Research Service, Washington, D.C.
INCREASING THE DATA TRANSMISSION EFFICIENCY OF CODE TELEMETERING SYSTEMS
V. I. Vasil'yev *In its* Izv. VUZOV: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 79–89 refs (See N65-14894 05-14) OTS: $6.00

With the use of the index of relative speed of transmission of information, an evaluation is made of the message transmission efficiency on utilizing various codes under conditions of the occurrence in the communication channel of pulse interferences of low and medium intensity. Author

N65-14905 Joint Publications Research Service, Washington, D.C.
NEW METHOD OF CONSTRUCTION OF SERIES DECODERS
Yu. I. Volkov and F. E. Keller *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 90–97 refs (See N65-14894 05-14) OTS: $6.00

A new method is considered of construction of series decoders for position codes having any base of code, which renders the output elements of the decoder capable of performing the functions of intermediate elements, thus providing the possibility of constructing networks with a number of elements equal to the number of output circuits of the decoder. A study is made of the characteristics of graphs upon which the method is based. A circuitry embodiment is shown for a decoder employing magnetic elements with a rectangular hysteresis loop (RHL). Author

N65-14907 Joint Publications Research Service, Washington, D.C.
SELECTION OF PARAMETERS OF A TWO-CHANNEL SERVOSYSTEM WITH A DIGITAL COMPUTER
A. N. Gerasimov and S. V. Luchko *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 109–118 refs (See N65-14894 05-14) OTS: $6.00

The article presents a method of calculation of a two-channel servosystem with identical channels and antisymmetrical interconnections, on inclusion in each channel of a digital computer. In solving the problem of synthesis of such systems the index of oscillation is taken as the quality criterion. The calculation procedure is illustrated by examples. Author

N65-14972# Boeing Co., Seattle, Wash.
HIGH SPEED PAM MULTIPLEXER RESEARCH AND DEVELOPMENT PROJECT
W. Gurany and R. V. Costanza [1964] 81 p refs
(D2-22661; AD-450930)

Circuits analysis, component selection, and construction of an eight-channel prototype PAM multiplexer have been completed. A welding technique for nickel matrix wires and conventional tinned copper component leads, and fabrication of cordwood-style modules with these techniques are reported. The development of a laminated, nickel-etched circuit, multilayer interconnection "mother" board for mounting the modules and the construction of a 32-channel engineering model multiplexer has been accomplished. The most significant conclusion has been the demonstration of a successful high-speed switch, proving the feasibility of accurate high-speed multiplexing. E.E.B.

N65-14979# Michigan U., Ann Arbor. Radio Science Lab.
OPTICAL PROCESSING OF ANTENNA ARRAYS FOR SIMULTANEOUSLY RESOLVING MANY SIGNALS IN BOTH BEARING AND FREQUENCY
William K. Huggett, Reuben J. Gronquist, Charles A. Davis, and Edwin E. Henry, Jr. Nov. 1964 70 p refs
(Contract DA-28-043-AMC-00013(E); Proj. Michigan)
(Rept.-6400-9-T; AD-451661)

The report presents the results of a theoretical and experimental investigation of optical processing of signals received by an antenna array. The Fourier transform properties of coherent optical systems have a natural application to antenna beam-forming. A continuous, multiple-beamed, phased array can be processed, optically, in such a fashion that many rf signals can be simultaneously resolved in both frequency and bearing. Experimental verification of the theory is also presented. The experimental breadboard utilizes an ultrasonic delay-line array to produce a real-time, sonic-wave analog of the electromagnetic waves received by the antenna array. Author

N65-14986# Naval Ordnance Lab., Corona, Calif. Electronics Div.
VLF SUPERDIRECTIVE ARRAY WIDEBAND COMPONENTS
E. W. Seeley 15 Oct. 1964 37 p refs
(NAVWEPS-8202; AD-607663) OTS: $3.00

If improperly designed, the loops, preamplifiers, mixers, and transmission lines tend to deteriorate the directivity of vlf superdirective arrays in which they are used. This report describes the characteristics required of these components when used experimentally in superdirective arrays. Reception patterns of these arrays and illustrations of the respective capabilities of the components are given. Author

N65-14993# Ohio State U. Research Foundation, Columbus.
THE INTELLIGIBILITY OF TWICE DETERIORATED SPEECH
John W. Black and Joseph G. Agnello (Temple U.) Sep. 1964 12 p refs
(Contract Nonr-495(18))
(TN-101; AD-607847)

Four aspects of distorted and controlled speech signals were tested with respect to the intelligibility of the signals: signal level, signal-to-noise ratio, the absence of acoustically weak segments, and periodic interruptions. Each distortion was represented in six degrees. From a mean intelligibility score of each condition, values of intelligibility were predicted for doubly distorted speech under assumptions that the distortions were nonoverlapping and that a pair of distortions should produce the joint effect of the two singly. Thus, the predictions were made by multiplying the values associated with individual distortions. The results were in keeping with the assumption that the intelligibility of an imperfect communication system can be estimated if the relative effects of individual deterrents to intelligibility in the system are known. Author

N65-14994# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Avionics Lab.
AN EVALUATION OF EXPERIMENTAL FERRITE SLOT ANTENNAS
Olin E. Horton Oct. 1964 51 p refs
(AL-TDR-64-250; AD-454082)

The antennas were designed for use where conventional-size antennas cannot be tolerated due to their size and configuration. The physical size of the solid-state antennas has been reduced to less than one percent of their free space volume. The radiation patterns of the solid-state antennas are comparable to their conventional counterparts. The gain and impedance bandwidths are greater than were theoretically predicted. Prior to completion of this evaluation, the antenna performance was further enhanced by a technique for magnetically tuning the antenna over a wide frequency band. It is, therefore, concluded that the size of antennas can be greatly reduced by ferrite loading, and are thus made suitable for application to many electronic systems on aerospace vehicles. Author

N65-15025# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
DEVELOPMENT OF A FIRE-RESISTANT WATER-BASE HYDRAULIC FLUID Bimonthly Progress Report, Sep. 1-Oct. 31, 1964
E. H. Kober and G. F. Ottmann [1964] 20 p ref
(Contract NObs-90268)
(BMPR-3; AD-607948) OTS: $1.00

Alkoxylation of amino diphenyl oxides, hydroxy diphenyl oxides, methylene diphenols, methylene dianilines and biphenol with ethylene oxide and/or glycidol resulted in water-soluble fluids. Many of these fluids met the target specifications for flash point, fire point, pour point, autogenous ignition temperature, but their aqueous solutions, adjusted to a viscosity of 28 ± 3 cs at 150° F, have viscosities which are in excess of 850 cs at 25° F. Alkoxylation products of tris (hydroxymethyl) phosphine oxide and of substituted hydroxymethyl phosphine oxides possessed unexpectedly low autogenous ignition temperatures in the range of 750° to 825° F. Author

N65-15074# Royal Canadian Air Force, Ottawa.
EXPERIMENTAL RESULTS ON FADING OF NOISE TYPE JAMMING SIGNALS IN L AND S FREQUENCY BANDS, PART II
B. J. Starkey and G. A. Fatum Nov. 1964 92 p refs
(REF-VF-64/4)

The report describes a series of field strength measurements of signals radiated by aircraft flying on radial courses to the measuring site. An attempt was made to analyze and identify individual fades in the ground interference pattern, and to calculate the effective earth's radius from the experimental data obtained. These data were also used to calculate ground reflection coefficients and the signal diffraction pattern caused by a hilly barrier. Author

N65-15098# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
QUARTERLY RADIO NOISE DATA JUNE, JULY, AUGUST, 1963
W. Q. Crichlow, R. T. Disney, and M. A. Jenkins 21 Aug. 1964 88 p refs
(NBS-TN-18-19) GPO: $0.50

Radio noise measurements from 18 network stations were made and tabulated, based on the mean power, the mean envelope voltage, and the mean logarithm of the envelope voltage. The antenna noise factors are for a short vertical antenna over a ground plane, and are expressed in decibels. The other two noise parameters are given relative to the mean power. G.G.

N65-15211# Mitre Corp., Bedford, Mass.
COMPARISON OF SIGNALLING EFFICIENCY IN WIDE-BAND COMMUNICATION SYSTEMS
J. W. F. Ye Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1963 16 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-63-437; TM-3851; AD-422599) OTS: $1.60

An investigation was made comparing the system performance improvement in a coded correlation communication system under heavy jamming environment for the following forms of message encoder and decoder; (1) simple reduction of the transmission rate, (2) simple repetition of the same symbol, and (3) application of error-correcting codes. The error-correcting codes were found to perform uniformly better than the other two schemes. For a rate reduction of 10, the antijamming margin gain achieved by the use of error-correcting codes is about 2 to 3 dB better than that obtained simply by reducing the transmission rate; the symbol repetition scheme is definitely not to be recommended under the same condition. A physical interpretation of the different behavior is also included. Author

N65-15212# Bendix Corp., Baltimore, Md. Bendix Radio Div.
METEOROLOGICAL TRACKING RADAR STUDY Final Report
G. R. Hetrich 31 Oct. 1963 123 p refs
(Contract AF 19(628)-2499)
(AFCRL-63-766; AD-423612) OTS: $10.10

An investigation of the technical and economic suitability and availability of the existing tracking radars for use with the Robin and Rose meteorological balloon targets is reported. Presented are a discussion of the problem, an analysis of system errors, and an examination of existing radars. It is recommended that a relatively inexpensive radar, consisting of the Prelort Pedestal and Servo System, be used in conjunction with specially tailored transmitter and receiver subsystems for a network of high-altitude research and data gathering centers. Modifications to the Prelort radar and to the balloon are suggested, and an examination of the present Robin tracking technique is discussed. D.E.W.

N65-15236# Mitre Corp., Bedford, Mass.
EFFICIENCY OF A ROUTING SCHEME IN A MOBILE DATA PROCESSING COMMUNICATION NETWORK
Paul Hamburger Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 33 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-635; W-06390/0000/01/1/00; AD-609774)

This document examines the efficiency of a routing scheme for mobile communication nodes with data processing capability. Expressions for evaluating its cost in data rate as a function of the pertinent system variables are given. The data rate cost is compared with that of broadcasting all messages. Author

N65-15243# Pennsylvania U., Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES: STUDIES OF ANTENNA SIDE-LOBE REDUCTION, VOLUME I Final Report
H. Kritikos, R. Dresp, and K. C. Lang Griffiss AFB, N.Y., RADC, Oct. 1964 78 p refs *Its* Rept.-64-25, Vol. I
(Contract AF 30(602)-2888)
(RADC-TDR-64-355, Vol. I; AD-609076)

A theoretical study and a discussion of actual applications are presented. A brief introduction of the common antenna synthesis procedures is given, and two new approaches are suggested: the use of the signal-to-noise ratio as a criterion of design of arrays; and the use of the prolate spheroidal functions for aperture synthesis. A number of high performance antennas are discussed. Practical techniques, such as tunneling application of microwave absorbing material, are described and evaluated. Author

N65-15244# Pennsylvania U., Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES. MULTIPLE USE OF ANTENNAS AND ANTENNA STACKING, VOLUME II Final Report
I. Shin Griffiss AFB, N.Y., RADC, Oct. 1964 53 p refs *Its* Rept.-64-25, Vol. II
(Contract AF 30(602)-2888)
(RADC-TDR-64-355, Vol. II; AD-609077)

The feasibility of the multiple use of a common antenna and stacking of several antennas on a small site is studied. The problems involved are found, and the techniques available based on current technology are discussed. It is concluded that a combination of multiplexing and stacking of antennas is feasible and desirable. Author

N65-15246# Pennsylvania U., Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES. DIRECTIONAL MODE COUPLERS Final Report, 1 Sep.–15 Dec. 1963
R. J. Kalagher Griffiss AFB, N.Y. RADC, Oct. 1964 15 p refs *Its* Rept.-64-25
(Contract AF 30(602)-2888)
(RADC-TDR-64-355, Vol. IV; AD-609079)

The properties of the waveguide directional couplers which couple to the second harmonic traveling in the TE_{10}. TE_{20}. TE_{01}. TE_{11}. and TM_{11} modes were re-examined theoretically and experimentally and no changes in their single-frequency narrow-band characteristics were observed. The 1.768 to 2.1 Gc frequency range of a coaxial directional coupler that couples only the TE_{11} mode was investigated by mode launchers similar to those used by Lind. The values obtained for coupling measurements were close to the theoretical curve over the entire range. Since the measured directivity fell off rapidly on each side of the design

frequency of the coupler and a longer coupler is impractical, a new design containing two sets of coupling apertures is proposed. The placing of the two holes—one at 2.86 Gc and the other at 2.1 Gc frequency—on opposite sides of a coaxial line will make the coupling almost constant over the entire range. G.G.

N65-15247# Pennsylvania U., Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES: STUDIES OF TRANSMITTER BANDWIDTH LIMITING AND SPURIOUS OUTPUT SUPPRESSION, VOLUME V Final Report
S. Srikantan Griffiss AFB, N.Y., RADC, Oct. 1964 36 p refs *Its* Rept.-64-25, Vol. V
(Contract AF 30(602)-2888)
(RADC-TDR-64-355, Vol. V; AD-609080)

A review of existing techniques for reducing intermodulation and harmonic distortion in radio transmitters is given. These techniques include linearization of amplifier stages by proper choice of tubes, tube design and operating point, the use of negative feedback, and predistortion of the signal to be amplified. Filtering was not considered in this study. It is shown theoretically that distortion can be reduced by multiphase amplifier techniques. This was checked experimentally on a three-phase amplifier at audio frequencies. The technique can be used at higher frequencies if the wideband phase-splitting networks can be designed. Author

N65-15248# Space-General Corp., El Monte, Calif.
EXPERIMENTAL RESEARCH INVESTIGATION OF EXTREMELY LOW FREQUENCY PROPAGATION Final Report, Apr.–May 1964
P. I. Kuhnle and R. D. Smith Griffiss AFB, N.Y., RADC, Dec. 1964 66 p refs
(Contract AF 30(602)-3385)
(SGC-491R-1; RADC-TDR-64-360; AD-609719)

Measurements were made of the characteristics of cw signals transmitted over a 400-cps link established between Bishop, California and Rome, New York, a distance of approximately 4000 km. A 67-mile section of power transmission line extending from Bishop, California to Silver Peak, Nevada was used to radiate the 400-cps energy. Data which could be reduced to yield signal strength, attenuation rate, transmission-path phase variations, and atmospheric-noise amplitude probability distributions (APD) were recorded at the Rome, New York receiver site. Data from the current and previous contract were compiled to show the range of measured propagation constants. Measurements are compared with path characteristics calculated using existing theoretical treatments of e.l.f. propagation. Samples of atmospheric noise impulse data and the corrresponding atmospheric noise amplitude probability distribution are presented. Author

N65-15275# Mitre Corp., Bedford, Mass.
THE EFFECTS OF MISMATCH AND DISTORTION ON THE OUTPUT SIGNAL OF A LINEAR FM PULSE-COMPRESSION FILTER
Manfred H. Ueberschaer Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 32 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-149; TM-04043/0000/00/0/00; AD-609478)

The output functions of the pulse-compression filter which correspond to the matched filter case and the mismatched case are compared. Numerical comparison is made for two pulse-compression systems of particular interest. The primary effect of mismatch is found to be a reduction in signal-to-noise ratio which, in the worst case considered, is less than 10 percent. Deviations from the idealized rectangular amplitude spectrum and linear group delay of the transmitted signal are considered. These deviations, which are viewed as distortions, are chosen to provide a more realistic representation of the transmitted signal. The output signal thus obtained is expressed as the sum of the original term and a distortion term. An upper bound for the phase difference caused by the distortion term is obtained and is found to be negligibly small. Author

N65-15278# Pennsylvania U. Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES: STUDY OF TECHNIQUES FOR SPECTRUM SIGNATURE MEASUREMENTS, VOLUME VI Final Report
R. C. Harper Griffiss AFB, N.Y., RADC, Oct. 1964 10 p *Its* Rept.-64-25, Vol. VI
(Contract AF 30(602)-2888)
(RADC-TDR-64-355, Vol. VI; AD-609175)

Reviewed are some special features of a spread spectrum communication transceiver, a ground-controlled approach radar, and two ballistic-missile early warning system radars to determine their effects on spectrum signature testing. The spectrum signature tests were performed on four equipments: GRC-115, AN/CPN-4, FPS-49, and FPS-50. Discussed are the following: (1) the nature of the study; (2) a brief system description and the reasons for investigating the four equipments; (3) the major recommendations made; (4) a discussion of the test equipment; and (5) a brief discussion of applicability of the AMS-13 and FSM-17 instrumented aircraft and of the Sperry erectable tower. For the four equipments studied, it was found necessary to specify in more detail how antenna patterns were to be taken, what provisions should be made for monopulse systems, what testing with a pulsed interfering signal was necessary, and what consideration should be given to MTI capabilities. R.R.D.

N65-15279# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
THE LAW OF THE MIXER: THE MUTUAL INTERFERENCE CHART FOR PROBLEMS OF FREQUENCY ASSIGNMENTS AND ITS APPROXIMATION
Nello R. Castellini Jul. 1963 25 p refs
(USAELRDL-TR-2376; AD-610008)

The mutual interference chart (MIC) defined by the formula for the spurious frequencies resulting from the mixing process is interpreted in terms of analytic geometry. The spurious-frequencies formula and the chart derived from it do not take complete account of the physics of the mixing process, i.e., they do not take cognizance of the effect of the impedance of the circuit and nonlinearities of the mixer on the amplitude of the input waves. When this is done, the number of lines of the MIC is radically reduced . The procedure for constructing the reduced or practical chart on the basis of the derived relation, the analytic character of the general chart lines, the quality of service desired, and experimental data is briefly outlined. The reduced chart is far simpler than that predicted by conventional theory and becomes even simpler as the frequency increases. There is also an approximation to it consisting solely of a diagonal swath. Author

N65-15286# Wolf Research and Development Corp., West Concord, Mass.
DATUM AND/OR STATION LOCATION FROM BALLISTIC CAMERA OBSERVATIONS ON SATELLITES
Harry R. Kahler Sep. 1964 33 p refs *Its* Rept.-64-3897-5
(Contract AF 19(628)-3897)
(AFCRL-64-872; AD-609040)

The results of a study to determine the accuracy with which datums can be positioned, relative to the geocenter from ballistic camera observations on a satellite, are presented. The study utilizes simulated observations on a postulated satelliteborne optical beacon. The satellite is taken to be in a 400-n. mi. low-eccentricity orbit. Recommendations are made for maximum utilization of such a satellite for geometric–geodetic purposes (i.e., datums and/or station location.) Conclusions are that a three-dimensional uncertainty of 5 to 10 m can be achieved utilizing the short arc technique (an arc of 4000 to 5000 miles.) It is felt that long arc reductions, for geometric purposes with ballistic camera observations only, are operationally impractical and although theoretically attractive should be dismissed as having any major potential in a geodetic satellite program. Author

N65-15289# Hughes Aircraft Co., Culver City, Calif.
STUDY OF ADVANCED ANTENNA SYSTEMS PROBLEMS FOR SPACE VEHICLES Final Report, Apr. 1961–Dec. 1964
A. T. Villeneuve Oct. 1964 18 p refs
(Contract AF 19(604)-8386)
(AFCRL-64-950; P64-105; AD-609703)

Summaries are presented of eight scientific reports covering *Multiple Target Response of Data Processing Antennas, Radiation through Cylindrical Plasma Sheaths, The Negative Conductance Slot Amplifier, An Experimental Negative Conductance Slot Amplifier at 6 Gc, A Waveguide Slot Switching Technique, Admittance of Waveguide Radiating into Plasma Environment, Radiation Patterns of Antennas on Plasma Enclosed Cylinders,* and *Propagation of Electromagnetic Waves through Inhomogeneous Slabs.* A study on the use of semiconductor diodes for control of the amplitude and phase of radiation from waveguide slots is also reported. Author

N65-15290# Sylvania Electric Products, Inc., Williamsville, N.Y. Sylvania Electronic Systems
MODIFICATIONS MADE TO THE USAF TRANSPORTABLE PASSIVE SATELLITE COMMUNICATIONS TERMINAL Final Report, 31 Jan. 1963–31 Aug. 1964
Henry Hyams et al Griffiss AFB, N.Y., RADC, Dec. 1964 140 p refs
(Contract AF 30(602)-2944)
(RADC-TDR-64-428; AD-609809)

Modifications include a new X-band feed structure to permit transmission and reception on either of two orthogonal linear polarizations, adding a diplexer to permit reception of an X-band signal while simultaneously transmitting a 10-kW X-band signal, and adding single sideband and double sideband suppressed carrier modulation capability to the existing frequency modulated transmitter. In addition, a stable frequency source was installed which has a stability and accuracy of better than one part in 10^9. Necessary frequency synthesizers were added to permit changing the transmit frequency from 7630 to 8330 Mc, and the antenna feed line was modified to permit operation at the new frequency of 8330 Mc. Author

N65-15301# General Electric Co., Schenectady, N.Y. Research Lab.
NEW STUDIES OF CALCIUM OXALATE MONOHYDRATE: A GUIDE TO THE INTERPRETATION OF THERMOGRAVIMETRIC MEASUREMENTS
E. L. Simons and A. E. Newkirk Aug. 1963 26 p refs
(Rept.-63-RL-3263C, Rev.)

The pyrolysis of calcium oxalate monohydrate under a variety of conditions gives rise to considerable differences in its thermograms. The effects of sample size, heating rate, atmosphere, and container geometry are presented in a series of paired thermograms, and the differences are accounted for with the aid of additional evidence from differential thermal analysis and from combustion train experiments. Variations in atmosphere are particularly important, and the atmospheres studied were dry nitrogen, humidified nitrogen, dry air, humidified air, dry oxygen, dry carbon dioxide, and dry carbon monoxide. Author

N65-15310# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
FEASIBILITY STUDY OF SHAPED-BEAM ANTENNAS FOR THE DEFENSE COMMUNICATION SATELLITE PROGRAM
H. E. King, J. L. Wong, and C. J. Zamites, Jr. 27 Nov. 1964 60 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-257; TRD-269(4111)-12; AD-425028)

The feasibility of beam-shaping antennas for attitude controlled satellites orbiting at 5000 n. mi. is investigated. The improvement in gain of an ideal shaped-beam antenna is compared to the gain of a conventional horn-type antenna. Assumptions of the main beamwidth and sidelobe levels of the shaped beam are made to permit the comparison. Depending upon the stabilization error, the improvement is in the order of 3 to 3.5 dB along the horizon. The crossed-dipole reflector array, horn-lens (circular aperture) antenna, polyrod antenna, and multihorn array are treated analytically. In addition to the analyses, experimental studies of the horn-lens antenna and polyrod antenna are reported. The experimental polyrod antenna provides an improvement of approximately 2 dB. The experimental horn-lens antenna provides an 0.8 dB improvement. Considerations are given to the improvement expected from an attitude stabilized synchronous altitude satellite. Author

N65-15312# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A RESTRAINED LEAST SQUARES SOLUTION TO THE RADAR PEDESTAL TILT PROBLEM
William L. Shepherd Jun. 1964 17 p refs
(ERDA-158; AD-444946)

An approximate solution for A, to the matrix equation

$$\underset{(3\times n)}{Y} = \underset{(3\times 3)}{A}\,\underset{(3\times n)}{X} \qquad n > 3,$$

subject to the restraint

$$A^T A = I,$$

is obtained and compared to the least squares solution. The problem arises in the radar pedestal tilt problem, and results in formulas for correction for tilt. The importance of the restraint in the empirical determination of transformation of coordinates is pointed out. Author

N65-15318# Colorado U., Boulder.
MODEL STUDY OF IONOSPHERE PERTURBATIONS AND PROPAGATION BETWEEN TWO SITES Quarterly Report, 1 Jul.–1 Oct. 1964
[1964] 3 p
(Contract NBS CST-7348; ARPA Order 183-62)
(QR-11; AD-450453)

In a study of ionosphere perturbations and propagations between two sites, tests of new phase recording equipment designed for greater accuracy and speed of phase measurements have proved successful. Direct recording of the data eliminates the need of further processing. For simulating curvature in the straight model waveguide, variations in the dielectric constant of plastic foams under compression indicate the possibility of fabricating a volume loading material with a linearly varying dielectric constant. Formulas for determining the necessary properties of dielectric materials for this purpose are given. Negotiations for samples of precut materials have been undertaken. M.G.J.

N65-15320# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A MINIMUM TELEMETRY RECEIVING SYSTEM FOR THE ALOUETTE TOPSIDE SOUNDER SATELLITE

Earl E. Ferguson and Richard G. Green 9 Oct. 1964 27 p (NBS-TN-222) OTS: $0.30

A description is given of a minimum telemetry receiving system used to receive topside ionospheric records from the Alouette (S-27) satellite. Instructions are included for the determination of telemetry antenna aiming angles to the satellite from any location on the surface of the earth. Author

N65-15330*# National Bureau of Standards, Boulder, Colo. Boulder Labs.

STATISTICAL PATTERNS OF LARGE PARABOLIC ANTENNAS

D. E. Culnan and R. E. Skerjanec 29 Oct. 1964 129 p refs (NASA Order R-68)

(NASA-CR-60311; NBS-8497) OTS: HC $4.00/MF $1.00

Antenna pattern measurements were made to examine the statistical distribution of relative gain for 18-m-diam parabolic reflectors at 4.85 and 9.1 GHz. Patterns were recorded on magnetic tape as the test antenna was rotated through all azimuth-elevation mount positions relative to a far field target exciter. Relative gain was analyzed in 2-dB increments by random sampling data for each 5° by 5° block of the hemisphere. Weighting was applied to produce uniform spacing of data samples and to reject low elevation angles. Relative gain patterns for two antennas over four earth profiles are similar and gain is approximately normally distributed. The report includes statistical medians, standard deviations, cumulative distributions, and patterns for vertical, horizontal, and cross polarization at both frequencies. Author

N65-15332*# Ohio State U. Research Foundation, Columbus. Antenna Lab.

EFFECT OF TAPER ANGLE VARIATION ON THE SUB-MILLIMETER, FAR-INFRARED TRANSMISSION EFFICIENCY OF LINEARLY TAPERED LIGHT PIPES

Glenn G. Shephard 26 May 1964 5 p *Its* Rept.-1093-20 (Grant NsG-74-60)

(NASA-CR-60299) OTS: HC $1.00/MF $0.50

An experiment, designed to determine empirically the magnitude of transmission change with taper angle, led to the following conclusions: (1) A tapered light pipe is definitely more efficient in the submillimeter far infrared than a nontapered pipe, as indicated by the nontapered transmission of 4.9 and the tapered average transmission of 7.4. (2) As unobservable differences in fabrication create greater transmission changes, the angle of taper on a tapered light pipe is relatively unimportant for most applications. M.G.J.

N65-15354# Joint Publications Research Service, Washington, D.C.

TRANSMISSION OF CLIPPED SPEECH SIGNALS USING PHASE TELEGRAPHY

N. T. Petrovich and N. I. Kozlenko 27 Jan. 1965 12 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), v. 19, no. 11, Nov. 1964 p 65–70

(JPRS-28485; TT-65-30207) OTS: $1.00

An experimental model was studied to select a method of compressing the dynamic range of speech signals for a system of phase telegraphy and also to compare the methods from the point of view of noise stability. The model consisted of two units, a limiter with filtering, and a direct limiter of the speech signal. In both units the limiters had a regulated maximum limiting threshold with degrees of limiting at 0, 20, 40, and 60 dB. A block diagram of the circuit is given. Results for limiting at 60 and at 40 dB are presented graphically, and these conclusions are drawn: The noise stability of a phase telegraphy system, in which the passband of the receiver is selected as 7.0 kc/sec and the degree of limiting is 60 dB, depends very little on the passband of the low frequency filters in the modulator during their variation within the limits of 3.8 to 10 kc/sec. For a degree of limiting of 40 to 60 dB it is necessary to introduce compensation of the low frequency characteristic in the modulator of the transmitter by raising the high frequency side. Other conclusions concern comparison with amplitude keying and comparison between 40 and 60 dB limiting. D.E.W.

N65-15360*# Alabama U. Research Inst., Huntsville.

PARTIAL WAVE ANALYSIS OF ELECTROMAGNETIC WAVE PROPAGATION IN INHOMOGENEOUS MEDIA

F. H. Mitchell, Jr. and F. J. Tischer 1 Nov. 1964 123 p refs (Grants NsG-381; NsG-608)

(NASA-CR-60138; UARI-18) OTS: HC $4.00/MF $1.00

A solution to several classes of plasma problems was found by applying a technique similar to that used in nonrelativistic quantum mechanics when studying particle scattering by partial waves. In both types of problems it is desired to find out how a varying index of refraction affects the propagation of incident waves. The solutions are represented as sums or integrals of Fourier components which represent the partial waves. When the inhomogeneous medium is removed, the partial waves are known for many cases of interest; when the spatially varying medium is reintroduced, each of these partial waves will change. It is convenient to define the partial wave phase shifts as the natural logarithm of the ratio of the new to the old partial waves. These phase shifts will in general be complex numbers. Author

N65-15383*# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.

890/960-MC TRANSPONDER, MARK II 100-CYCLE BANDWIDTH Final Report

Warren Dahl and Don Hummels 1 Nov. 1963 145 p Prepared for JPL

(Contracts NAS7-100; JPL-950461)

(NASA-CR-60313; FW-2954) OTS: HC $4.00/MF $1.00

This document describes the version of the Mark II transponder which was modified to improve its reliability, and which has a threshold bandwidth of 100 cps. There is a detailed description of the transponder system and equipment, the procedures for alignment and testing of the transponder system and equipment, and a documentation section listing specifications, drawings, reports, and other pertinent data. Author

N65-15396# Joint Publications Research Service, Washington, D.C.

ON THE CODING OF SIGNALS WITH MULTIPLEX PHASE-DIFFERENCE MANIPULATION

Yu. B. Okunev 28 Jan. 1965 11 p ref Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 2, 1964 p 8-14
(JPRS-28526; TT-65-30225) OTS: $1.00

Certain problems of coding signals with multiplex phase-difference manipulation are analyzed. Basic laws governing the appropriate codes are derived. The problems are: (1) binary number transmission, (2) transmission of n independent binary numbers with a scheme for finding the optimum code. The laws derived deal with common characteristics of closed codes and characteristics of 3-plex closed codes. Solutions are found for problems of all 3-plex codes, and the ratio between the noise stabilities of individual tracks has been found. By inverting all binary symbols, three different 3-plex closed codes can be formed. R.E.S.

N65-15398# Joint Publications Research Service, Washington, D.C.

RADAR INVESTIGATIONS OF REFLECTION FROM A CLEAR SKY

A. A. Chernikov 29 Jan. 1965 56 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), v. 48, 1963 p 56-97
(JPRS-28548; TT-65-30234) OTS: $3.00

The use of various radar methods of investigating reflecting objects has made it possible, in addition to general concepts of seasonal and diurnal variations in the concentration, intensity, and other characteristics of echoes, to obtain information on the movement, structure, and form of reflection sources. This has been the basis for constructing the corresponding physical model of the phenomenon observed. Author

N65-15399# Joint Publications Research Service, Washington, D.C.

RADIO RELAY SYSTEMS DESIGN

A. I. Kalinin 1 Feb. 1965 236 p refs Transl. into ENGLISH of the book "Raschet Trass Radioreleynykh Liniy" Moscow, 1964 p 1-247
(JPRS-28575; TT-65-30252) OTS: $6.00

CONTENTS:

PART I—CERTAIN GENERAL QUESTIONS ON RADIOWAVE PROPAGATION
1. THE PROPAGATION OF RADIOWAVES IN A UNIFORM, LIMITLESS MEDIUM p 3-17
2. RADIOWAVE REFLECTION p 18-47

PART II—PROPAGATION OF ULTRASHORT WAVES TO DISTANCES ON THE ORDER OF THE LIMIT OF DIRECT VISIBILITY
3. PROPAGATION OF ULTRASHORT WAVES ALONG THE SMOOTH SPHERICAL SURFACE OF THE EARTH WHEN THE TROPOSPHERE IS UNIFORM p 48-76
4. PROPAGATION OF ULTRASHORT WAVES ALONG THE SMOOTH SPHERICAL SURFACE OF THE EARTH WHEN THE TROPOSPHERE IS NOT UNIFORM p 77-97
5. EFFECT OF LOCAL TERRAIN AND REFRACTION CONDITIONS ON PROPAGATION OF ULTRASHORT WAVES p 98-127
6. FADING WHEN ULTRASHORT WAVES ARE PROPAGATED TO DISTANCES ON THE ORDER OF THE LIMIT OF DIRECT VISIBILITY p 128-163

PART III—DISTANT TROPOSPHERIC PROPAGATION OF ULTRASHORT WAVES
7. EXPERIMENTAL DATA p 164-185
8. THEORETICAL EXPLANATIONS OF EXPERIMENTAL RESULTS p 186-201

PART IV—SELECTION AND CALCULATION OF THE ROUTE OF RADIORELAY LINES
9. ALLOWABLE NOISE LEVEL VALUES AT THE OUTPUT OF RADIORELAY LINES p 202-208
10. CALCULATION OF NOISE LEVELS AT THE OUTPUT OF RADIORELAY LINES p 209-223

N65-15406*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TELEMETRY AND COMMAND TECHNIQUES FOR PLANETARY SPACECRAFT

J. C. Springett 15 Jan. 1965 39 p refs
(Contract NAS7-100)
(NASA-CR-60336; JPL-TR-32-495) OTS: HC $2.00/MF $0.50

Communication with planetary spacecraft, where system constraints allow data rates of only a few bits per second, requires that the method used to obtain synchronization does not significantly degrade the theoretical performance of the link. A method is presented whereby bit and word synchronization can be achieved without the use of zero-crossing detectors and without the inclusion of sync words within the data format. The modulation and detection system makes use of maximal-length linear shift-register codes in conjunction with phase-lock techniques to achieve unambiguous code synchronization from which bit sync, word sync, and coherent demodulation signals can be obtained. In addition, the data bits and the sync code are combined mod-2, thereby realizing an optimum system from the standpoint of providing all of the available transmitter sideband power to the data signal, as well as the synchronization signal. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-14524# System Development Corp., Santa Monica, Calif.

FACTORS THAT AFFECT THE COST OF COMPUTER PROGRAMMING. VOLUME II: A QUANTITATIVE ANALYSIS

L. Farr and H. J. Zagorski Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1964 131 p refs
(Contract AF 19(628)-3418)
(TM-1447/001/00; ESD-TDR-64-448, Vol. II; AD-607546)

Results of an exploratory analysis aimed at deriving better cost-estimating relationships for computer programing development are presented. Based upon previous work that hypothesized an initial list of factors affecting cost, the report describes the steps taken to collect and analyze data for the purpose of supporting or rejecting the presumed factors. As a result, equations that estimate costs in terms of such resources as man months and computer hours have been derived. Since these estimating devices were evolved from a small and, perhaps, unrepresentative sample of programs, the use of these equations is not recommended for actual

planning. The study concludes that multivariate regression analysis, supplemented by pertinent judgment and intuition, is an appropriate tool for deriving cost-estimating relationships. Author

N65-14537*# Midwest Applied Science Corp., Lafayette, Ind.
OPERATION MANUAL FOR CONICAL SHELL PROGRAM
John E. Goldberg and Dale W. Alspaugh Mar. 1964 18 p
Its Rept.-64-5 Suppl. to MASC-63-13
(Contract NAS8-1674)
(NASA-CR-60052; MASC-63-13) OTS: HC $1.00/MF $0.50

A high-speed digital computer program is presented, which accepts the values of all parameters pertaining to the geometry of the shell as input data. The specification of loads is made by writing FORTRAN function subprograms. The program consists of a main program, six subroutines, five FORTRAN functions, and input data cards. G.G.

N65-14627*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A FORTRAN PROGRAM TO CALCULATE THE FLOW FIELD AND PERFORMANCE OF AN AXIALLY SYMMETRIC deLAVAL NOZZLE
D. Thompson, E. H. Ingram, C. T. K. Young, and J. B. Cox
Washington, NASA, Jan. 1965 157 p refs
(NASA-TN-D-2579) OTS: HC $5.00/MF $1.00

A FORTRAN IV computer program was developed for calculation of the flow pattern and performance of axially symmetric deLaval nozzles, using the axially symmetric method of characteristics for isentropic flow. The program computes thermodynamic and gas-dynamic properties throughout the flow field and performance parameters (e.g. thrust, specific impulse, etc.) at various stations. The capabilities, limitations, optional features, physical structure and use of this program are described in detail. Author

N65-14719# Lincoln Lab., Mass. Inst. of Tech., Lexington.
HAYSTACK POINTING SYSTEM: EPHEMERIS TAPE PROGRAM Group Report 1964-41
D. M. Hafford 25 Sep. 1964 81 p
(Contract AF 19(628)-500)
(ESD-TDR-64-379; AD-450196)

This report is a description of an IBM 7094 program which takes, as input, the ephemerides of the sun, moon and certain planets, the Besselian Day numbers and Northern Hemisphere J-Numbers, and the apparent sidereal time for 0^h Universal Time from tape or cards acquired from the Naval Observatory, checks them for certain errors, and transcribes these data onto a tape for use by the Haystack pointing system. Author

N65-14769 Joint Publications Research Service, Washington, D.C.
ON OPTIMIZATION OF COMPLEX CHEMICAL-TECHNOLOGICAL SYSTEMS
G. M. Ostrovskiy *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 88-99 refs (See N65-14762 05-10) OTS: $6.00

A method is described for finding the derivatives of an optimized quantity with respect to the control variables for a series of typical chemical technological systems. The optimization of the following sequence of devices is considered: (1) a system with a fixed number of input variables and an undertermined number of output variables; (2) a system with a variable number of input variables and an undetermined number of output variables; and (3) a system with a fixed number of input and output variables. Also investigated is the problem of optimizing a sequence of devices with feedback and the problem of optimizing sequential-parallel systems. It is shown that by using the proposed method, the optimized variables depends to a very small degree on the number of control variables N. For large N, this significantly decreases the number of calculations. P.V.E.

N65-14814# Iowa State U. of Science and Tech., Ames.
PATTERSON SUPERPOSITION SYSTEM FOR THE IBM 7074
D. R. Fitzwater, T. R. Johnston, D. H. Erbeck, and M. K. Rhyne Aug. 1964 25 p
(Contract W-7405-ENG-82)
(IS-954) OTS: $2.00

A system is described which aids in resolving the N(N−1) peaks that appear on a Patterson Map into the fundamental set of N vectors corresponding to the N atoms. Author

N65-14831# American Power Jet Co., Ridgefield, N.J.
COMPUTER PREDICTION OF ENVIRONMENTAL EFFECTS ON USAF MATERIEL
George Chernowitz, Samuel J. Bailey, and Sol Gurman Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 226 p refs
(Contract AF 33(657)-8736)
(FDL-TDR-64-107; AD-609280)

This report covers the theory and use of computer techniques which will enable environmental test engineers to obtain information on the probable effects of various environmental elements, the required tests to insure environmental reliability, the hazardous combinations of materials and environments, the location and availability of test facilities, and similar environment–equipment relationship data. The system recommended is designed as an environment-oriented center which will be expanded and made increasingly useful by the addition of service modules. Each module improves the sophistication of the system by modifying queries for optimum response, by seeking environmental data from users of the service, by analyzing failure distribution data to provide equipment–environment failure data matrices, indicating hazardous combinations of materials for exotic environments, and by providing similar advanced and self-improving services as the need for such services becomes known. Author

N65-14909 Joint Publications Research Service, Washington, D.C.
SINGLE-DIGIT DECIMAL ADDER EMPLOYING FERRITE-TRANSISTOR CELLS
A. M. Kayumov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 123-127 refs (See N65-14894 05-14) OTS: $6.00

Described is the scheme of a single-digit decimal adder employing standard ferrite transistors and utilizing the "2 out of 5" code. The adder differs from those in current use by the feature that the adding is effected directly with a "2 out of 5" code without changeover to "1 out of 10" code, which simplifies the circuit of the adder and enhances its reliability. Author

N65-14940# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
INVESTIGATION AND IMPROVEMENT OF THE LANNET
Glen David Wilson (M.S. Thesis) Aug. 1964 117 p refs
(GE/EE/64-21; AD-607756)

The purpose of this investigation is to simulate and modify the LANNET in order to improve its problem solving behavior in a maze. A limited analysis of the unmodified LANNET is made to establish a basis for evaluating improvements. The improvements to the LANNET are optimum path solution for a spatial array, optimum learning rate, and increase in maze size from 8 × 8 to 24 × 24. It is conjectured that the optimum path innovation could be the basis for a vehicle guidance system. The LANNET model developed is shown to be more useful for research than the actual machine. Author

N65-14991# Iowa State U. of Science and Tech., Ames. Ames Lab.
LCR-2, A FORTRAN LATTICE CONSTANT REFINEMENT PROGRAM
Donald E. Williams Nov. 1964 17 p
(Contract W-7405-ENG-82)
(IS-1052) OTS: $1.00

This report describes a computer program which refines lattice constants for any crystal symmetry by the least squares method. Several types of extrapolation functions are provided, and these functions can be used either singly or in combination. A complete error treatment is made, including covariances between parameters. Author

N65-15003# Canada. Dept. of Transport, Toronto. Meteorological Branch
A LABORATORY TIME BASE GENERATOR
H. Goldberg and W. R. Smith 24 Feb. 1964 12 p
(CIR-3995; TEC-510)

This paper describes a unit designed and constructed for the purpose of generating short pulses at known rates in terms of the power-line frequency. Design considerations are given together with a theoretical discussion of the solid-state packages available; the implementation into a practical circuit is touched on. Logic and wiring diagrams of the final unit are included. Author

N65-15009# Princeton U., N.J. Frick Chemical Lab.
GENERAL FOURIER AND SUPERPOSITION FOURIER PROGRAMS (CDC 1604) Technical Report No. 3
Robert A. Jacobson Aug. 1964 41 p refs
(Grant DA-ARO(D)-31-124-G265)
(AROD-3083-14; AD-604652)

The Fourier program is designed to compute electron density, or Patterson maps, or other similar Fourier functions using relatively small amounts of computing time. Maps can be computed in intervals of 240ths of the unit cell or larger, and the output is in two-character coded format, modular 1024. The superposition Fourier program is designed to superimpose Patterson maps using BC tape images in a buffered fashion and to produce the resultant map in coded and BC formats. The average computation time is 3 to 5 minutes. Author

N65-15097# Union Carbide Nuclear Co., Oak Ridge, Tenn. Systems Programming Dept.
THE SHARE ALGOL 60 TRANSLATOR FOR THE IBM 709/7090/7094
Marjorie P. Lietzke, ed. 20 Jan. 1965 164 p
(Contract W-7405-ENG-26)
(K-1614) OTS: $5.00

The translator operates under the FORTRAN II version II monitor system on the IBM 709/7090/7094, and consists of a Supervisor and six phases, each one of which performs a specific function in the translation process. This report gives a general introduction to the entire system, as well as a detailed description of each phase. The descriptions included here, together with the program which is available from the SHARE distribution agency, make it possible for a programer to operate, maintain, and, if desired, modify the translator. Author

N65-15122# Electronic Associates, Inc., Princeton, N.J. Research and Computation Div.
PROGRAMMING STUDIES FOR RADIO SIGNAL RAY TRACING Final Report
David Basson 31 May 1964 89 p
(Contract AF 19(628)-1658)
(AFCRL-64-449; AD-609070)

An analog computer program and solution for the problem of 5-kc radio ray tracing in two dimensions simulating the ionosphere, exosphere, and hypothesized plasma ducts is presented. Suitable forms for computer implementation of three-dimensional ray tracing at low frequencies are derived. A general analysis of the scaling problems for ray tracing at frequencies from 5 kc to 14 Mc is also presented, and a complete computer program for 3D ray tracing at 4 Mc is presented. A tropospheric ray tracing study that incorporated a two-dimensional function of refractive index was also undertaken on the HYDAC 2000 digital–analog computer. Data were obtained and a complete set of runs was made. The results confirmed the feasibility of this approach. Author

N65-15124# International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
COMPUTER PROGRAMMING TECHNIQUES FOR INTELLIGENCE ANALYST APPLICATION Technical Documentary Report, Feb. 16–May 15, 1964
Griffiss AFB, N.Y., RADC, Oct. 1964 182 p refs
(Contract AF 30(602)-3303)
(RADC-TDR-64-310; AD-608727)

Extensive modifications on the monitor and application programs of the AN/GYA complex has resulted in the successful performance of program processing, loading, and testing as an integrated operation under control of a multiprocessor. This feature has also permitted updating the statistical language library during monitor operation, and modifying and extending programs for all applications of the AN/GYA system. Additional distribution functions have been programed for inclusion in STORM and on the AN/GYA disk. A list-processing language has been defined, and is being programed, to facilitate inclusion of prototype studies in the lay user's system. Experimental programs have also been developed to determine statistical word association, and the clear text system has been augmented by novel encoding features to permit faster search. M.G.J.

N65-15168# European Atomic Energy Community, Brussels (Belgium).
AIREK-MOD: A MODIFIED VERSION OF THE KINETIC CODE AIREK II
Carla Mongini-Tamagnini Aug. 1964 35 p refs
(EUR-1914.e) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 50 Belg. Fr.

The code AIREK II, which solves the kinetic equations with respect to time, has been modified. In particular, standard forms for the subroutines giving, respectively, the reactivity

versus time, the stop conditions, and the output specifications, have been developed. Besides the possibility of feedback variables, derivatives depending on feedback variables other than the one considered have been introduced. Author

N65-15219*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE JPL THERMOCHEMISTRY AND NORMAL SHOCK COMPUTER PROGRAM
T. E. Horton 1 Nov. 1964 42 p refs
(Contract NAS7-100)
(NASA-CR-60257; JPL-TR-32-660) OTS: HC $2.00/MF $0.50

A computer program capable of calculating chemical equilibrium properties associated with traveling, standing, and reflected normal shocks has been developed. The initial gas mixture, temperature, and pressure can be varied with ease. The program can also be used to generate Mollier thermodynamic data and chemical composition at selected temperatures and densities. Both dissociation and ionization effects are considered in the temperature range of 2000° to 20 000° K. At the present time, the program is set up to consider mixtures (containing up to 36 species) which are composed of carbon, nitrogen, oxygen, and argon. Author

N65-15257# California U., Livermore. Lawrence Radiation Lab.
CRUD—A FISSION-PRODUCT DIFFUSION CODE FOR THE CDC 3600 AND IBM 7094
G. M. Litton and C. R. Hunt 1 Sep. 1964 42 p refs
(Contract W-7405-ENG-48)
(UCRL-12064) OTS: $2.00

The CRUD program solves the equations describing fission product diffusion in slab-geometry fuel elements. Decay chains with up to nine members may be treated. The fission source for any isotope must be spatially uniform but may be assigned an arbitrary time dependence. The primary outputs of the code are time-dependent concentration profiles and leakage rates for each species of a decay chain. Arbitrary initial concentration profiles may be assigned to the chain members. The code contains an option for the inclusion of recoil effects. Author

N65-15263# Argonne National Lab., Ill. Chemistry Div.
A FORTRAN PROGRAM TO ANALYZE MASS SPECTROMETER ION OPTICS
Kurt Kaiser Aug. 1964 26 p refs
(Contract W-31-109-ENG-38)
(ANL-6903) OTS: $1.00

A FORTRAN program is described for the computation of ion–optical aberration coefficients through second order for any number of tandem electric and magnetic sector fields, such as those used in multistaged mass spectrometers. Also computed are the image positions and their magnifications, the system mass dispersion, and the inclinations of the direction- and energy-focusing planes with respect to the optic axis. Author

N65-15287# Wolf Research and Development Corp., West Concord, Mass.
THE ATTRIBUTE DERIVATION AND DISPLAY SYSTEM FOR THE EXPERIMENTAL DYNAMIC PROCESSOR Final Report
Jerome Cohn, Richard Gagan, Robert Keim, and Marilyn Wisowaty 30 Sep. 1964 67 p
(Contract AF 19(628)-1614)
(AFCRL-64-890; AD-609488)

A new version of the Attribute Extraction program for the Experimental Dynamic Processor is described. This new version takes advantage of the drum storage and display capability of the Digigraphic equipment that has been added to the DX-1. The several display programs and the Attribute program have been made compatible and work under a common executive routine, the Dexter system. The order of solvable matrices has been increased from 50 to 160. Some preliminary results are given. The special display programs are described. The Power method to find eigenvalues and eigenvectors of large matrices is described. A simulation of a proposed optical eigenvalue and eigenvector processor is described. Author

N65-15377*# George Washington U., Washington, D.C. Biological Sciences Communication Project
ABSTRACTING AND INDEXING COVERAGE OF THE LITERATURE OF SPACE BIOLOGY
Richard H. Amacher and Joe W. Tyson [1964] 22 p
(Grant NsG-485)
(NASA-CR-60326) OTS: HC $1.00/MF $0.50

A total of 147 research papers pertaining to space biology, which were published in 1962, were selected from 31 sources. In addition, 480 papers published during the period 1959–1964 were selected because the authors are current grantees–contractors of the National Aeronautics and Space Administration. For the first group of 147 titles, a search was made in four abstracting–indexing journals. For the second group of 480 titles, a search was made in six abstracting–indexing journals. Of the first group of 147 papers, 68.3% were found in one or more of the four abstracting–indexing journals. Of the second group of 480 papers, 59.4% were found in one or more of the six abstracting–indexing journals examined. In three abstracting–indexing journals, the abstract usually appeared during the original publication year of the paper concerned. If an abstract did not appear by the end of the first postpublication year, it was unlikely to appear at a later date. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-14587# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
AN INVESTIGATION OF A P-INDUCED CHANNEL INSULATED-GATE FIELD-EFFECT TRANSISTOR
Kevin Grant Stogsdill (M.S. Thesis) Aug. 1964 54 p refs
(GE/EE/64-19; AD-607483) OTS: $3.00

The analysis and use of the p-induced channel insulated-gate field-effect transistor were investigated. A simplified charge distribution analysis and the experimental determination of the figures of merit, A_ω, A_p, and A_v were utilized to predict the operation of the P-ICFET in the rf range. A short circuit admittance parameter equivalent model, which was modified to include regenerative effects, was completed with the subsequent design and construction of an 100 Mc/sec amplifier and oscillator. The typical P-ICFET amplifier exhibited a power gain of 8 to 15 dB and as an oscillator had a power output of 2 to 4 mW at an efficiency of 20% to 40%. Author

N65-14678# Michigan U., Ann Arbor. Electron Physics Lab.
RESEARCH ON CROSSED-FIELD ELECTRON DEVICES Interim Scientific Report No. 3, Sep. 1–Mar. 1, 1964
T. A. De Massa, S. G. Lele, N. A. Masnari, J. E. Rowe, and K. L. Volkholz Mar. 1964 129 p refs
(Contract DA-36-039-AMC-00027(E))
(Rept.-05361-8-5; AD-446441)

The nonlinear M-BWO investigations are described with the results indicating efficiencies in excess of 40% under certain operating conditions. The investigations also include the analysis of severed circuits and parametric interaction in drifting crossed-field electron beams. The most recent S-band crossed-field amplifier has been operated under dc conditions, and the data indicates essential agreement with the theory. The theoretical large-signal interaction study resulted in the attainment of a closed-form solution which agrees to within 4% of the digital computer solutions. Some additional results from the Monte Carlo analysis of the noise phenomenon in crossed-field devices are described and analyzed. An abbreviated Kino short gun is described and analyzed by means of a digital computer. Also, large-signal interaction equations are formulated in terms of an emitting-sole device. Author

N65-14695# General Electric Co., Schnectady, N.Y. Power Tube Dept.
DISTRIBUTED AMPLIFIER TUBES Final Report, 1 May 1962–30 Jul. 1963
C. B. Mayer [1963] 60 p refs
(Contract DA-36-039-SC-90743)
(Rept.-19; AD-423932)

This report describes the continuation of the research work on a single tube distributed amplifier. The major improvements which have been made in the tube are increased anode dissipation capability, increased screen-grid dissipation capability and stability, and improved emission. These improvements, along with circuitry studies and modifications, have led to improvements in frequency bandwidth, power output, and power gain. Author

N65-14706# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Solid State and Frequency Control Div.
X-BAND SEMICONDUCTOR SWITCHING AND LIMITING USING WAVEGUIDE SERIES TEES
V. J. Higgins Mar. 1963 28 p refs
(USAELRDL-TR-2349; AD-405778)

This report describes a new microwave semiconductor switching technique X-band. This technique uses various types of varactor diodes operating in a series mode. Series mode switching is obtained by cascading several E-plane tee junctions. Each tee is terminated in a fixed tuned crystal mount. A diode when inserted in its holder is spaced in an integral half guide wavelength from the junction of the series arm and the main waveguide, and each series arm is separated by odd integers of quarter wavelengths. Isolations of 30 to 48 dB and insertion losses of 0.3 to 0.8 dB were obtained at a frequency of 9375 Mc/s. Details of a semiconductor X-band power limiter are given. The limiter consists of the same configuration as the switch except that it is not externally biased. Isolations of 20 to 30 dB over a bandwidth of 180 to 250 Mc/s and insertion loss of 1.2 dB and less over a 500 Mc/s bandwidth were noted. Author

N65-14726# Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZOV: RADIO ENGINEERING, VOL. VII, NO. 4, 1964
4 Jan. 1965 183 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. VII, no. 4, Jul.–Aug. 1964 p 405–542
(JPRS-28085; TT-65-30031) OTS: $5.00

CONTENTS:

1. CERTAIN PROPERTIES AND APPLICATIONS OF DIELECTRIC CRYSTALS IN WHICH THE CURRENT IS DETERMINED BY THE SPACE CHARGE Yu. N. Fost p 1–17 refs (N65-14727 05-26)

2. UNITRON-COUPLED SYMMETRICAL TRIGGER A. N. Karmazinskiy p 18–32 refs (N65-14728 05-09)

3. AN ANALYSIS OF THE STATIC OPERATING CONDITIONS OF TRIGGERS COUPLED DIRECTLY WITH UNITRONS A. N. Karmazinskiy p 33–43 refs (See N65-14729 05-09)

4. THE INDUCTIVE PROPERTIES OF LOW-VOLTAGE DYNISTORS V. I. Vaganov and V. S. Pershenkov p 44–53 refs (See N65-14730 05-09)

5. PARALLEL-CONNECTED TRIGGER WITH A LOW-VOLTAGE DYNISTOR V. I. Vaganov, V. S. Pershenkov , and I. P. Stepanenko p 54–71 refs (See N65-14731 05-09)

6. SERIES-CONNECTED TRIGGER WITH LOW-VOLTAGE DYNISTOR V. I. Vaganov and V. S. Pershenkov p 72–79 ref (See N65-14732 05-09)

7. THE BUILD-UP TIME OF THE FRONT IN TRANSISTORIZED MULTISTAGE AMPLIFIERS Yu. A. Volkov p 80–86 refs (See N65-14733 05-10)

8. TRANSFER CHARACTERISTICS OF TRANSISTOR WITH ELECTRICAL FIELD VARYING ALONG THE BASE V. V. Galitskiy p 87–96 refs (See N65-14734 05-09)

9. ANALYSING AMPLIFIERS WITH DISTRIBUTED PARAMETERS BY TAKING INTO ACCOUNT THE TRANSFER ADMITTANCE OF THE AMPLIFYING COMPONENTS A. A. Kuz'min p 97–107 refs (See N65-14735 05-09)

10. TWO-CIRCUIT SELF-GENERATOR OF HARMONIC OSCILLATIONS USING A TUNNEL DIODE N. A. Novinskiy p 108–117 refs (See N65-14736 05-09)

11. CALCULATION OF PARTIAL ADMITTANCES (CAPACITANCES) IN CERTAIN TWO-DIMENSIONAL SYSTEMS Ye. B. Mekhantsev p 118–126 refs (See N65-14737 05-09)

12. CONCERNING THE ELECTRICAL DESIGN OF UNITS OF PHOTOELECTRIC IMAGE TRANSLATORS A. I. Petrenko and V. K. Yeliseyev p 127–136 refs (See N65-14738 05-09)

13. NEW METHOD OF CALIBRATING MILLIVOLTMETERS FOR EFFECTIVE AND AVERAGE AMPLITUDE VALVES Yu. M. Tuz p 137–141 refs (See N65-14739 05-09)

14. TWO-STAGE DECELERATION OF ELECTRONS IN O-TYPE CARCINOTRONS AND TRAVELING-WAVE TUBES V. V. Murav'yev and V. I. Shevchenko p 142–149 refs (See N65-14740 05-09)

15. STRUCTURAL CHARACTERISTICS AND RELIABILITY OF CERAMIC TUBE CAPACITORS A. N. Franchuk p 150–153 refs (See N65-14741 05-09)

16. CONCERNING THE SELECTION OF MODULATION FREQUENCY IN MEASURING SCHEMES FOR PERIODIC COMPARISON Yu. A. Skripnik and Ye. S. Tolmachev p 154–158 refs (See N65-14742 05-09)

17. CONCERNING THE CALCULATION OF ALLOWABLE OPERATING CURRENT IN GERMANIUM AND SILICON GATES Yu. M. Kalnibolotskiy p 159–164 refs (See N65-14743 05-09)

18. THE COUPLING IMPEDANCE OF BENT DELAY-SYSTEMS Yu. A. Deyneka p 165–171 refs (See N65-14744 05-09)

N65-14728 Joint Publications Research Service, Washington, D.C.
UNITRON-COUPLED SYMMETRICAL TRIGGERS
A. N. Karmazinskiy *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 18–32 refs (See N65-14726 05-09) OTS: $5.00

The static conditions of unitron-coupled triggers are analyzed. A cutoff factor of assurance is introduced which describes the closed state of a triode. The trigger's loading capacity is analyzed. An example of trigger calculations is given. Author

N65-14729 Joint Publications Research Service, Washington, D.C.
AN ANALYSIS OF THE STATIC OPERATING CONDITIONS OF TRIGGERS COUPLED DIRECTLY WITH UNITRONS
A. N. Karmazinskiy *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 33–43 refs (See N65-14726 05-09) OTS: $5.00

The static conditions of triggers coupled directly to p- and n-types of unitrons are analyzed, and their use in solid circuits is considered. In deriving the formulas, an approximation of unitron volt–ampere characteristics, the N_T characteristic of the trigger, the locations of effective trigger points and resistance values, current leakages, reverse junction current, variations in supply and cutoff voltages of the unitron, and trigger symmetry, are incorporated. Results show that optimal relations between trigger parameters are obtained by considering the condition that assures cascade coordination and information transmission in circuits with directly coupled unitrons. This condition also makes it possible to determine the optimal load which depends on supply voltage and on the allowance for unitron and circuit parameters. An optimal load corresponds to a maximum current of the N_T characteristic of the trigger, which equals the maximum current of the N_y characteristic. The analysis also makes it possible to consider the asymmetry of unitron parameters in designing solid circuits. M.G.J.

N65-14730 Joint Publications Research Service, Washington, D.C.
THE INDUCTIVE PROPERTIES OF LOW-VOLTAGE DYNISTORS
V. I. Vaganov and V. S. Pershenkov *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 44–53 refs (See N65-14726 05-09) OTS: $5.00

To determine the inductive properties of low voltage p-n-p-n diodes (dynistors), an analysis was made of its volt–ampere characteristic and the relationship between resistance and reactance as functions of operating conditions and frequency. An equivalent tunnel-diode circuit was designed, the volt–ampere characteristic plotted, and the capacitance measured. These parameters determine the unknown coefficients in an approximated expression of volt–ampere characteristic and thus the analytic parameters for the equivalent circuit are obtained. Both the linear resistance and the inductance depend on operating conditions and frequency. From the analyzed equivalent circuit, a single expression of the volt–ampere characteristic, and signals in the form of series-connected resistance and inductance are obtained. It was also determined that with increasing temperatures both the inductance and modulus of the negative resistance are sharply reduced. Experimental and analytic results are in substantial agreement. M.G.J.

N65-14731 Joint Publications Research Service, Washington, D.C.
PARALLEL-CONNECTED TRIGGER WITH A LOW-VOLTAGE DYNISTOR
V. I. Vaganov, V. S. Pershenkov, and I. P. Stepanenko *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 54–71 refs (See N65-14726 05-09) OTS: $5.00

The subject is a dynistor-coupled trigger that eliminates the basic defects of a trigger using a unit with negative resistance. A static calculation of the circuit is given and direct matching of triggers is analyzed. Author

N65-14732 Joint Publications Research Service, Washington, D.C.
SERIES-CONNECTED TRIGGER WITH LOW-VOLTAGE DYNISTOR
V. I. Vaganov and V. S. Pershenkov *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 72–79 refs (See N65-14726 05-09) OTS: $5.00

This article contains a static calculation for series-connected trigger using a dynistor (p-n-p-n diodes). It examines the features of this system as compared with parallel-connected triggers. Author

N65-14734 Joint Publications Research Service, Washington, D.C.
TRANSFER CHARACTERISTICS OF TRANSISTOR WITH ELECTRICAL FIELD VARYING ALONG THE BASE
V. V. Galitskiy *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 87–96 refs (See N65-14726 05-09) OTS: $5.00

The effect of a built-in electrical field on the transfer characteristics of transistors is analyzed. The variation in the field along the base is considered. Transfer characteristics are investigated with the aid of a modelled transistor base of a long RC line. Author

N65-14735 Joint Publications Research Service, Washington, D.C.
ANALYSING AMPLIFIERS WITH DISTRIBUTED PARAMETERS BY TAKING INTO ACCOUNT THE TRANSFER ADMITTANCE OF THE AMPLIFYING COMPONENTS
A. A. Kuz'min *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 97–107 refs (See N65-14726 05-09) OTS: $5.00

A description of the matrix method of analyzing an amplifier stage having distributed parameters by taking into account the transfer–admittance of the amplifying units. An equation is derived for the gain factor of a stage with matching half-links, for any value of the load-resistance by taking into account the transfer-admittance. An approximated condition is found for the steady-state of the stage with distributed parameters. Author

N65-14736 Joint Publications Research Service, Washington, D.C.
TWO-CIRCUIT SELF-GENERATOR OF HARMONIC OSCILLATIONS USING A TUNNEL DIODE
N. A. Novinskiy *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan 1965 p 108–117 refs (See N65-14726 05-09) OTS: $5.00

An analysis of a two-circuit self-generator of harmonic oscillations using a tunnel diode is made. Experimental results are given. Author

N65-14737 Joint Publications Research Service, Washington, D.C.
CALCULATION OF PARTIAL ADMITTANCES (CAPACITANCES) IN CERTAIN TWO-DIMENSIONAL SYSTEMS

Ye. B. Mekhantsev *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 118–126 refs (See N65-14726 05-09) OTS: $5.00

The method of conformal mapping is used to calculate the partial admittances in a symmetrical system of three and in an asymmetrical system of two flat conductors located on a base with a rectangular cross section, or in shape of a strip. Engineering equations are given, and the results of calculation are illustrated. Author

N65-14738 Joint Publications Research Service, Washington, D.C.

CONCERNING THE ELECTRICAL DESIGN OF UNITS OF PHOTOELECTRIC IMAGE TRANSLATORS

A. I. Petrenko and V. K. Yeliseyev *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 127–136 refs (See N65-14726 05-09) OTS: $5.00

Analyzed are factors affecting the parameters of output signals of photoelectric image translators. Methods are proposed for efficient designing of output devices for photoelectric translators that make it possible to reduce considerably the influence exerted by these factors on the performance of devices which convert different types of graphic information into electrical signals. Author

N65-14739 Joint Publications Research Service, Washington, D.C.

NEW METHOD OF CALIBRATING MILLIVOLTMETERS FOR EFFECTIVE AND AVERAGE AMPLITUDE VALVES

Yu. M. Tuz *In its* Izv. VUZov: Radio Eng. Vol. VII, No. 4, 1964 4 Jan. 1965 p 137–141 refs (See N65-14726 05-09) OTS: $5.00

A new method is described of calibrating mVm for effective and average amplitude values based on the use of silicon stabilitrons for a two-sided limitation of rectangular voltages. Equations are derived and errors are determined of devices for effective and average values due to disrupted symmetry in rectangular voltages. Experimental data are obtained from testing the calibrator and also the basic technical characteristics of a calibrator model. Author

N65-14740 Joint Publications Research Service, Washington, D.C.

TWO-STAGE DECELERATION OF ELECTRONS IN O-TYPE CARCINOTRONS AND TRAVELING-WAVE TUBES

V.V. Murav'yev and V. I. Shevchenko *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 142–149 refs (See N65-14726 05-09) OTS: $5.00

The calculation of maximum-attainable efficiencies in carcinotrons and traveling-wave tubes (TW-tubes) with a two-stage deceleration is based on the integral distribution of electrons by their energies upon their emergence from space of interaction. A collector-circuit is given for a two-stage deceleration of electrons in the collector field. Author

N65-14741 Joint Publications Research Service, Washington, D.C.

STRUCTURAL CHARACTERISTICS AND RELIABILITY OF CERAMIC TUBE CAPACITORS

A. N. Franchuk *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 150–153 refs (See N65-14726 05-09) OTS: $5.00

To determine reliability and structural characteristics, ceramic tube capacitors have been tested continuously for 2000 hours, with an electrical load of 500 volts dc, and surrounding temperature of 80° ±5° C. Results show a relationship between reliability and the thickness of the dielectric and active area of the capacitor. Failure intensities increase as dielectric thickness decreases, due to the increase in stress gradient of the electrical field. Use of capacitors with dielectric thickness, for which the electrical field tension gradient is between 1000 to 1200 V/mm, is recommended for improved reliability. An increase in the capacitor's active or electrode overlap area reduces the electrical strength of the dielectric, due to possible structural weaknesses in the ceramic material, and consequently reduces the capacitor's reliability. M.G.J.

N65-14742 Joint Publications Research Service, Washington, D.C.

CONCERNING THE SELECTION OF MODULATION FREQUENCY IN MEASURING SCHEMES FOR PERIODIC COMPARISON

Yu. A. Skripnik and Ye. S. Tolmachev *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 154–158 refs (See N65-14726 05-09) OTS: $5.00

From periodic comparison of two voltages with a reference voltage, an amplitude-modulated voltage can be shaped, with the percentage modulation determined by amplitude and phase relationships of the compared voltages. Errors due to the amplitude and phase nonidentities of the comparing channels can be eliminated and high sensitivity for the measuring instruments obtained, as the following examples show. When used as modulators, switches have a finite commutation time, and the value of the errors introduced determines selection of the modulation frequency. By specifying the allowable error and the residual asymmetry of the modulating voltage, the maximum modulation frequency can be determined. Circuits of rectangular-shaped controlling generators usually provide for an initial adjustment of porosity, and the residual asymmetry can be eliminated by a calibrating operation. Experimental results indicate that a change in porosity of the controlling voltage, due to the instability of circuit parameters, does not exceed 0.5% to 1% per 8 hours of continuous modulation. M.G.J.

N65-14743 Joint Publications Research Service, Washington, D.C.

CONCERNING THE CALCULATION OF ALLOWABLE OPERATING CURRENT IN GERMANIUM AND SILICON GATES

Yu. M. Kalnibolotskiy *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 159–164 refs (See N65-14726 05-09) OTS: $5.00

To determine the maximum allowable current in germanium and silicon gates, the circuit, load, and surrounding temperature are considered. Formulas have been devised to show the relationship between the coefficient of the shape of current and pulse duration for an active load, an inductance, and a capacitance, and to show the dependence of the constant component and effective value of the back voltage on the duration of the anode-current for Gratz, LaToure, and simple two- and three-phase circuits. Use of these calculations can raise the allowable direct current by 20 to 40 percent in many cases and improve the reliability of devices with germanium and silicon gates. M.G.J.

N65-14744 Joint Publications Research Service, Washington, D.C.

THE COUPLING IMPEDANCE OF BENT DELAY-SYSTEMS

Yu. A. Deyneka *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 165–171 refs (See N65-14726 05-09) OTS: $5.00

Possible use of bent delay systems for accelerating elementary particles has prompted a study on the effect of the bend on the energy parameter-coupling impedance. Calculations to determine the coupling impedance of uniformly bent homogeneous comb, infinitely extended in an axial direction, show that the bend results in an increased coupling impedance. Therefore, in calculating the coupling impedance for accelerators, an equation for a bent curve must be used. Basic formulas have been extended to obtain the coupling impedance of a homogeneous bent comb, and bent combs with and without metal base. Comparison is also made of the relationship between the coupling impedance of a straight comb and the delay. M.G.J.

N65-14756# IIT Industrial Labs., Fort Wayne, Ind.
RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF IATRON DIRECT VIEW STORAGE TUBES, PHASE II Interim Development Report, 2 Jun.–2 Sep. 1964
R. W. Hunter 28 Oct. 1964 18 p ref
(Contract NObsr-87264)
(AD-607614) OTS: $1.00

To determine the effect of the backing electrode mesh number on resolution, a special Iatron direct view storage tube, containing a 500 mesh collector and a backing electrode mounting plate with holes (1.25 in. diameter) centered on a 2-in. bolt circle, was built and tested. Different meshes, containing 250, 500, 750, and 1000 holes per inch, were stretched over each hole, so that four different backing electrodes in a single tube could be evaluated. Results show that the width of a stored line is a linearly increasing function of the percentage of saturation brightness, and that the slope of this function is determined by the backing electrode mesh number and the gradients on each side of the storage target. Resolution improves with increasing mesh number at higher percentages of saturation brightness, although it is essentially the same at about 5% with various backing meshes. Increasing the gradient between the viewing screen and the backing electrode on 750 or 1000 mesh screens also improves resolution, possibly as a result of reduced transit time. M.G.J.

N65-14777 Joint Publications Research Service, Washington, D.C.
ASYMPTOTIC DISTRIBUTION OF LIFETIME OF A DOUBLED ELEMENT
A. D. Solov'yev *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 170–173 ref (See N65-14762 05-10) OTS: $6.00

Considered is a system in which two identical elements are placed in parallel. One of the identical circuits is placed in reserve, while the second one carries the load. By combining laws for the distribution of the lifetime of each individual element and for the distribution of the time repair of an individual element, a law is developed for the lifetime of the combination. P.V.E.

N65-14778 Joint Publications Research Service, Washington, D.C.
ON RELIABILITY OF TWO RESERVED REPAIRED SYSTEMS WITH ONE SERVICE POINT
I. P. Paderno *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 174–183 refs (See N65-14762 05-10) OTS: $6.00

Groups of two systems are investigated which consist of two (a basic and a reserve) single-type subsystems. Breakdown of each system occurs when all of the subsystems in it breakdown. Repair operations take place at one service point. Basic equations are presented for determination of probabilities of different states of the group, and a simple procedure is given for finding the values of work done up to the first breakdown, both of the individual systems and of the group. On the basis of theoretical analysis and clarifying example, approximate formulas are presented for determination of reliability parameters for small values of loading the service point. The calculated formulas may be generalized to systems with a number of basic subsystems which differ from one. Author

N65-14795# Bendix Corp., Southfield, Mich. Research Labs. Div.
EXPLORATORY DEVELOPMENT OF THE Q-FACTOR TECHNIQUE. SECTION I: RESULTS AND DISCUSSION OF FIRST NEUTRON TEST Third Quarterly Progress Letter
Max Frank 15 Dec. 1964 20 p
(Contract AF 29(601)-6316)
(Rept.-2797; AD-609396)

This report presents damage constant comparisons for 2N1613 transistors irradiated both passively and in several operating conditions in a neutron environment of 7×10^{13} n/cm^2, $E > 0.1$ MeV. Comparisons of damage are also made for three different temperatures during irradiation and three different measurement temperatures to determine the influence of each temperature condition. The damage constant behavior for 2N709, 2N914, and 2N1613 transistors was investigated at different levels of measurement current, from 10^{-5} to 10^{-1} A. Author

N65-14808# Weapons Research Establishment (Australia).
WRS 5, GRAPHICAL SYMBOLS FOR ELECTRICAL, ELECTRONIC, AND TELECOMMUNICATION PURPOSES
[1964] 184 p
(STD-WRS-5)

Graphic symbols for electrical, electronic, and telecommunication purposes that have been approved by the Weapons Research Establishment Standardization Committee, Salisbury, South Australia, are presented. Based upon the standards of the International Electrotechnical Commission, the British Standards Institution, and the Australian Post Office Engineering Instruction S0100, the symbols are to be adopted throughout the Establishment and supersede all previous standards on the subject. M.G.J.

N65-14821# Weston Instruments, Inc., Newark, N.J.
LOW BAND PASS-TRANSFORMER, EX 23, MOD O Final Report, 1 Jul. 1962–30 Jun. 1964
[1964] 53 p
(Contract N1178-8080)
(AD-601922)

The transformer is designed to operate from an excitation of 45 W for a period of 1.0 msec, minimum, over the passband frequency range of 100 cps to 10 kc/sec; at 28 V 400 cps it will deliver a minimum of 11.3 W (6 dB) to a 1-ohm resistive load. It is capable of dissipating continuously 10 W of incident power over the stop-band frequency range of 100 kc/sec to 10 kMc/sec and has a power attenuation of 40 dB minimum above 100 kc/sec into a 1-ohm resistive load. The unit is cylindrical, 1.38 inches in diameter and 2.0 inches long excluding connectors, and weighs 182 g. Author

N65-14919 Joint Publications Research Service, Washington, D.C.
THERMAL REGIMES FOR SEMICONDUCTOR DIODES IN A-C CIRCUITS
A. A. Abdulayev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 190–196 refs (See N65-14894 05-14) OTS: $6.00

Results are given of a study made of the thermal regime of diodes based on substituting for them a doubled electrical circuit consisting of two resistors and two capacitors. Formulas obtained for estimating the dynamic properties periodic pulses are applied. Author

N65-14920 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE THERMAL REGIMES OF SEMICONDUCTOR DEVICES BY THE EQUIVALENT CIRCUIT METHOD
P. D. Davydov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 197–205 refs (See N65-14894 05-14) OTS: $6.00

An investigation was made of nonstationary thermal regimes of semiconductor devices by using the method of equivalent circuits. Mathematical relations are given for finding the temperature of a p-n junction in transient modes (heating and cooling). Special attention is devoted to defining the relations between the thermal parameters of a real device and the equivalent circuit. Specific thermal parameters obtained experimentally are given for a large group of semiconductor devices. Author

N65-15000# General Electric Co., Schenectady, N.Y. Tube Dept.
PRODUCTION ENGINEERING MEASURE FOR VOLTAGE-TUNABLE MAGNETRONS Quarterly Progress Report, 18 Apr.–18 Jul. 1964
E. G. Soulier [1964] 31 p refs
(Contract DA-36-039-SC-86722)
(QPR-9; AD-607804) OTS: $2.00

The yield percentages obtained at the various basic tube subassembly stages are given. Results of vibration FM performance on the ZM-6103 and ZM-6104 packages are stated; conclusions, based on these results, are also included. Test data and illustrations are presented to substantiate these conclusions. Results of the engineering samples that were retested are given. A comparison of the present specification with the proposed specification is included. Author

N65-15065# California U., Livermore. Lawrence Radiation Lab.
RELIABILITY AND FAILURE OF ELECTRONIC EQUIPMENT, SYSTEMS, AND MATHEMATICAL MODELS: A BIBLIOGRAPHY
Carlotta M. Vidoni Oct. 1964 62 p refs
(Contract W-7405-ENG-48)
(UCRL-12040)

N65-15099 Tung-Sol Electric, Inc., Bloomfield, N.J. Research Div.
HIGH SPEED POWER AMPLIFIER USING ELECTRON BEAM SWITCHED P-N JUNCTIONS Final Development Report, 26 Jun. 1963–26 Jun. 1964
H. A. R. Wegener et al 21 Aug. 1964 12 p refs
(Contract NObsr-89493)
(AD-604115)

A 20 kV electron beam multiplier (EBM) tube has been made to deliver a 10 A positive pulse of one microsecond or more in duration at 100 to 1000 pps. The diode voltage was 125 volts (saturation point). Another tube delivered an 8 A pulse at 70 V. The current gain has been consistently in the order of 5000. A modified standard TV electron gun gave −40 V grid cutoff at a beam current of 4 mA and 20 kV anode potential. Slightly different modifications gave −13 V cutoff at 1.0 mA beam current. There is every indication that a further modification could give −20 V or less cutoff at a beam current of 3 to 4 mA based on the most recent experimental guns. Deterioration problems encountered in the diode are analyzed. Author

N65-15103# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
PREPARATION AND EVALUATION OF VACUUM-DEPOSITED NICKEL-CHROMIUM THIN-FILM RESISTORS
I. H. Pratt and J. J. Mc Carthy Jul. 1964 50 p refs
(TR-2418; AD-608910)

Results of studies of some properties of thin-film nickel–chromium resistors are presented. Nichrome (80% Ni, 20% Cr) was vacuum evaporated and deposited through masks in 5-, 10-, 20-, and 40-mil-wide strips onto various planar, substrates (e.g., glass, mylar, micro-module alumina wafers) with different surface characteristics. The following parameters and their interdependencies were measured and studied: sheet resistivity (ohms per square), film thickness, aging conditions (postdeposition static heat treatment), substrate surface and material, temperature coefficient of resistance, film temperature under various conditions, effect of line width and sheet resistivity on maximum power dissipation, statistical distribution and spread for some of these parameters, as a criterion for the degree of their reproducibility and controllability. Author

N65-15104# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
HOLLOW CATHODES IN NEGATIVE-GRID TUBES
George C. Fincke, Jr. Oct. 1964 13 p refs
(ECOM-2507; AD-608480)

This study involved factors important to the successful operation of hollow cathodes in negative-grid tubes: 1) activation rate; 2) mechanism of operation; and 3) grid action with truncated pyramidal hollow cathodes. A method of reducing the activation rate by ten-fold was investigated and achieved. The mechanism of operation was studied utilizing sectionalized cathodes. Results tend to confirm the postulated theoretical model. Unusual grid-control characteristics associated with hollow cathodes were experimentally derived and indicated the basis for the observed transconductance limitation. Author

N65-15107# TRW Semiconductors Inc., Lawndale, Calif. Engineering Dept.
PRODUCTION ENGINEERING MEASURE: RELIABILITY THRU PROCESS IMPROVEMENT (2N1506), VOLUME I Final Report, 25 Jun. 1962–17 Apr. 1964
R. Austin, G. Kamienski, and P. Kellow [1964] 142 p
(Contract DA-36-039-SC-86742)
(TRWS-3000-43, Vol. I; AD-608371)

Production techniques developed to increase the reliability of the 2N1506 silicon triple-diffused transistor to a maximum operating failure rate of 0.01% per thousand hours at a 90% confidence level at 25° C are outlined. The basic processes considered in detail were in specified areas of material evaluation, impurity diffusion, contact metallizing, contact lead attachment, collector attachment, final preparation prior to sealing, and cap welding. P.V.E.

N65-15217*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DELAY-LOCK AROD SYSTEM STUDY, VOLUME I Final Report, 17 Apr.–17 Nov. 1964

Richard A. Dye, John J. Downing, and Robert B. Ward 17 Nov. 1964 77 p refs
(Contract NAS8-11170)
(NASA-CR-60251; LMSC-4-89-64-1) OTS: HC $3.00/MF $0.75

The Delay-Lock AROD System accomplishes precision range and velocity measurements through appropriate phase-lock processing of an S-band carrier which is modulated by a single maximal-length binary sequence. Considerable simplification is thus achieved, compared to conventional systems which use a multiplicity of sinusoidal modulations to accomplish an unambiguous measurement of high resolution. Direct readouts of range and range rate are provided. In addition, it is possible to accommodate the two-way transmission of command data, and the measurement of altitude, without need for auxiliary systems. A capability is also provided for the same vehicleborne equipment to operate in conjunction with three types of ground transponders, of differing degrees of complexity. Thus, for less demanding missions, the expense of implementing an excess system capability need not be incurred. Author

N65-15220*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AC RATIO TRANSFORMER TECHNIQUE FOR PRECISION INSERTION LOSS MEASUREMENTS
C. J. Finnie, D. Schuster, and T. Y. Otoshi 30 Nov. 1964 21 p refs
(NASA7-100)
(NASA-CR-60254; JPL-TR-32-690) OTS: HC $1.00/MF $0.50

A simple high-precision insertion-loss measuring system has been developed which can be made to approach the accuracy of a high-quality standard ratio transformer. It is believed that an overall accuracy of ±0.003 dB has been obtained for a measurement of approximately 0.5 dB. Relative accuracies to 0.001 dB should be obtainable at this level. Detection is accomplished by means of a conventional dual-channel bolometer system; comparison is by an ac ratio transformer. Because of the normal bolometer limitations, measurements in one step are limited to insertion loss values of 20 to 30 dB. Excellent agreement was obtained between measured and theoretical attenuations of specially developed rotary-vane attenuators. Author

N65-15221*# IIT Research Inst., Chicago, Ill.
ELECTRICAL CONTACT MATERIALS FOR SPACE VEHICLE SYSTEMS Final Report, 30 Jun. 1961–30 Jun. 1963
W. H. Graft and J. L. Radnik [1963] 81 p refs
(Contract NAS8-2443)
(NASA-CR-60255) OTS: HC $3.00/MF $0.75

An experimental study of materials for low-level contacts was performed to establish optimum materials for reliable electrical connectors in space vehicle systems. Materials were evaluated by determination of the electrical performance of sample contacts during extended exposures to salt spray, sulfide, indoor, and unprotected outdoor environments. Contacts having a 100μin. plate of soft gold or hard gold alloys performed consistently better than those having a thin 20μin. plate. Solid precious-metal alloy systems also showed uniformity. Systems comprised of soft gold and gold alloys over stainless steel demonstrated excellent long-term performance in the sulfide, indoor, and outdoor environments, and have good potential for low-level contacts. A barrier plate was found to be effective with some overlay materials, particularly in the sulfide exposure group. Author

N65-15249# Radio Corp. of America, Princeton, N.J. RCA Labs.
CRYOELECTRIC RANDOM ACCESS MEMORY PHASE II—10^9 BIT MEMORY Final Report, Mar. 1, 1963–Feb. 28, 1964
L. L. Burns, D. Boswick, D. A. Christiansen, L. S. Cosentino, J. Fejer et al Griffiss AFB, N.Y., RADC, Nov. 1964 255 p refs
(Contract AF 30(602)-3090)
(RADC-TDR-64-376; AD-609469)

Tests of the many samples made during the year have established that the matching of memory planes with the necessary cryotron trees is practical. This phase of the program closed with the successful testing of a 128 by 128 memory plane containing 16384 cells and 508 cryotrons in the trees. Only a problem with unexpectedly low dense signals from the center portion of the plane prevented the stacking of a group of these planes. Improved high-speed evaporation plants have greatly increased the yield of experimental samples and improved their quality. Continued advances in mask fabrication techniques have provided methods that are suitable for the finer patterns required for 512-by-512 and 1024-by-1024 planes. Related work on high-speed selection trees employing cryotrons is reported. It is shown that cryotrons are suitable for this application but further work is necessary to reduce the heat dissipation. Author

N65-15293# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research
ELECTRON-IONIZATION CROSS SECTIONS Semiannual Progress Report, 15 Jun.–15 Dec. 1963
C. K. Crawford and C. E. Woodward [1963] 16 p refs
(Contract AF 33(657)-10939)
(5APR-1; AD-607661)

This period was devoted to improving the existing equipment. Work areas included the completion and testing of an ultrahigh-gain electron multiplier, the installation of a new quadrupole lens, construction of a simple gas test source, testing of the spectrometer, construction of a new pulse quantizer, theoretical exploration of the ion transmission between the spectrometer and the electron multiplier, and studies of the data-handling problems in the pulse electronics. Except for a tendency to short out, the new electron multiplier operates satisfactorily, whereas the new quadrupole lens does not. Author

N65-15295# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME 2: INTEGRATED AMPLIFIER Interim Technical Documentary Report No. 1
Herbert Kroemer Jul. 1963 37 p refs
(Contract AF 33(657)-11015)
(Varian-307-1C; ASD-TDR-63; AD-607985)

The objective of the integrated amplifier project reported in this volume is to study solid-state amplifiers that utilize the negative resistance of tunnel diodes, as an amplifying mechanism, in combination with the nonreciprocity of the Hall effect in Hall-effect isolators, as a directionality giving mechanism. Of the different possible kinds of nonreciprocal Hall-effect devices the unidirectional Hall isolator was selected for further study. A parallelogram geometry is given which automatically leads to a completely unidirectional isolator rather than a more general type of Hall-effect device. The output impedance of this isolator follows from simple geometrical considerations; a computer program was initiated to determine input and transfer impedance. Several kinds of basic amplifiers are possible by combining tunnel diodes with Hall isolators.

The most promising ones use a series push-pull pair of tunnel diodes connected in parallel with the isolator, either across the input or the output terminals, or both. The influence of the frequency-dependence of the tunnel diodes was studied. Author

N65-15344# Rome U. (Italy). School of Aerospace Engineering
SOME MODERN CIRCUITS FOR SPATIAL APPLICATION [ALCUNI NUOVI CIRCUITI PER APPLICAZIONI SPAZIALI]
Giovanni Pellegrineschi Apr. 1964 36 p refs In ITALIAN *Its* Atti del Centro Ricerche Aerospaziali No. 3

Part of the telemetry of the San Marco satellite and an active circuit to perform the operation $\sqrt{X^2 + Y^2 + Z^2}$ on the three components X, Y, and Z of the aerodynamic resistance measured by an installed dynamometer are described. Other circuits are examined in degree of performing the same operation, and the reasons which have determined the choice are discussed. D.E.W.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-14536*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
SINGLE PARAMETER TESTING. PHASE A: COMPLETION REPORT
E. L. Berger and J. C. Jackson 12 Nov. 1964 72 p refs *Its* Rept.-64-Simar-59/2
(Contract NAS8-11715)
(NASA-CR-60047) OTS: HC $3.00/MF $0.75

Techniques were developed for growing exponentials as a probing signal for single parameter testing, as well as for the optimization of feedback control for system testing. These methods, developed to test linear passive first- and second-order transfer functions, can be applied directly to the solution of single parameter testing of linear passive networks and constitute savings in checkout time, faster isolation of failure, and less degradation of performance due to testing. G.G.

N65-14546# General Electric Co., Palo Alto, Calif. Palo Alto Tube Operation
SUPPRESSION OF SPURIOUS EMISSIONS Final Report, Apr. 1963–Apr. 1964
R. H. Stone, R. Z. Gerlack, and C. K. Birdsall Griffiss AFB, N.Y., RADC, Sep. 1964 221 p refs
(Contract AF 30(602)-2955)
(TIS-R64ELM247-4; RADC-TDR-64-227; AD-608661)

Details of this analysis include survey and investigation of open periodic structures to determine which structures are most suitable to filtering, investigation of various microwave transitions for matching between the periodic circuit and standard transmission lines, and investigation of absorber media to remove scattered energy. Throughout the program a major effort was made to compile basic design data. Experimental devices were directed toward the L-band frequency region with design goals of (1) insertion loss less than 0.1 dB, (2) power-handling capacity up to a 10-MW peak, (3) VSWR of less than 1.4:1, and (4) harmonic and spurious frequency attenuation of 60 dB. Author

N65-14577 Martin Co., Baltimore, Md. RIAS Div.
RESEARCH ON CONTROL SYSTEMS Final Report, 15 Nov. 1962–30 Sep. 1964
R. E. Kalman Sep. 1964 14 p refs
(Contract AF 49(638)-1206)
(AFOSR-64-1788; AD-607567) OTS: $1.00

Stability theory, optimal control and calculus of variations, stochastic variational problems and optimal filters, finite automata, and applied mathematics and digital computation are the areas being researched on control systems. Although considerable progress is reported in achieving stochastic optimal control and filtering and the problems are now properly formulated, results on overall stochastic optimization show no real practical significance and further research is indicated. Application of the algebraic theory of finite machines to the engineering design has also been studied, with many problems still being investigated. Development of a Super-FORTRAN for optimization calculations is proceeding, aimed at devising a simple system for use by engineers not fully familiar with the mathematical intricacies of the theory. M.G.J.

N65-14690# European Atomic Energy Community, Brussels (Belgium).
MINIMUM NUMBER OF RELAYS IN AN ELEMENTARY SWITCHING SYSTEM [MINIMISATION DU NOMBRE DE RELAIS DANS UNE COMMUTATRICE ELEMENTAIRE]
P. Camion Apr. 1964 15 p refs In FRENCH; ENGLISH summary
(EUR-1626.f) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

By using the theory of graphs a scheme proposed for the realization of certain switching purposes is optimal. The scheme contains the minimum number of relays. The given proof suggests other solutions for the realization of supplementary purposes with the same number of relays. Author

N65-14712# Warnecke Electron Tubes, Inc., Des Plaines, Ill.
STUDY OF INTERACTION STRUCTURES LEADING TO DEVELOPMENT OF X-BAND CROSSED-FIELD AMPLIFIER, PHASE I Final Engineering Report, 28 Jun. 1963–28 Jun. 1964
C. C. Conner et al Washington, Navy Dept., 15 Aug. 1964 84 p refs
(Contract NObsr-89504)
(AD-607752) OTS: $3.00

The first phase of the program has been concerned with achieving a delay line structure suitable for a crossed-field amplifier with the following characteristics: 2-kW cw output, 7 to 11 Gc/sec, 50% efficiency, and 20-dB gain. A "fenced line" formed by photoengraving of copper on a support of polished sapphire has been selected as the delay-line structure giving the most promise. The technology for the photoformed line on sapphire has been proven using an intermediate layer of titanium to bond the copper to the support, photoetching, then thickening subsequently by copper plating. Cold testing of S-band scale models has indicated that the dissymmetric fenced line is advantageous in terms of suppressing unwanted modes, but is more dispersive than would be desired and interacts with only the center part of the beam. Author

N65-14733 Joint Publications Research Service, Washington, D.C.
THE BUILD-UP TIME OF THE FRONT IN TRANSISTORIZED MULTISTAGE AMPLIFIERS
Yu. A. Volkov *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 80–86 refs (See N65-14726 05-09) OTS: $5.00

An equation expressed in terms of certain equivalent time-constants of individual stages is given for the buildup time of the front in transistorized multistage amplifiers. It emphasizes the feature of this equation as compared with a similar equation for the stages in tubes. Author

N65-14762# Joint Publications Research Service, Washington, D.C.
TECHNICAL CYBERNETICS, NO. 5, 1964
4 Jan. 1965 266 p refs Transl. into ENGLISH of Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), no. 5, Sep.–Oct. 1964 p 1–184
(JPRS-28088; TT-65-30032) OTS: $6.00

CONTENTS:

1. VARIATION IN ENTROPY OF CONTINUOUS DYNAMIC SYSTEMS A. A. Krasovskiy p 1–18 refs (See N65-14763 05-10)

2. ON APPLICATION OF MATHEMATICAL PROGRAMMING PROCEDURES TO THE PROBLEM OF OPTIMAL CONTROL L. S. Gnoyenskiy and S. M. Movshovich p 19–39 refs (See N65-14764 05-10)

3. CONSTRUCTION OF AN OPTIMAL ALGORITHM FOR EXTREMAL CONTROL ON THE BASIS OF THE PRINCIPLE OF DYNAMIC PROGRAMMING E. A. Mozgovaya and Yu. I. Samoylenko p 40–52 refs (See N65-14765 05-10)

4. ON THE THEORY OF APPROXIMATE SYNTHESIS OF OPTIMAL CONTROL V. N. Kalinin p 53–61 refs (See N65-14766 05-10)

5. OPTIMAL CONTROL IN HEATING OF MASSIVE BODIES Yu. N. Andreyev and A. G. Butkovskiy p 62–75 refs (See N65-14767 05-33)

6. DETERMINATION OF THE OPTIMAL CONDITION OF A REACTOR OF CONTINUOUS EFFECT N. D. Dazkesa-Manskiy p 76–87 refs (See N65-14768 05-23)

7. ON OPTIMIZATION OF COMPLEX CHEMICAL-TECHNOLOGICAL SYSTEMS G. M. Ostrovskiy p 88–99 refs (See N65-14769 05-08)

8. OPTIMAL CONTROL OF A CLASS OF MULTI-RELATED SYSTEMS O. I. Larichev p 100–113 refs (See N65-14770 05-10)

9. ON THE PROBLEM OF ANALYTICAL CONSTRUCTION OF REGULATORS V. N. Romanenko p 114–122 refs (See N65-14771 05-10)

10. SOLUTION OF A SPECIAL CASE OF THE WIENER EQUATION M. G. Zotov p 123–130 refs (See N65-14772 05-10)

11. ON THE DYNAMICS OF AUTOMATIC SYSTEMS OF DISCRETE CONTROL CONTAINING CONSERVATIVE OR OSCILLATING LINKS S. M. Fedorov p 131–141 refs (See N65-14773 05-10)

12. OPTIMAL DISTRIBUTION OF THE LIMITED MEANS FOR CONVEX-CONCAVE PAYOFF FUNCTION I. N. Kuznetsov p 142–152 refs (See N65-14774 05-07)

13. ON IDLE DOUBLING WITH REPAIR FOR ANY LAW OF DISTRIBUTION OF FLOW OF BREAKDOWNS AND TIME OF REPAIR A. F. Zubova p 153–158 refs (See N65-14775 05-10)

14. ON DOUBLING WITH REPAIR B. V. Gnedenko p 159–169 refs (See N65-14776 05-10)

15. ASYMPTOTIC DISTRIBUTION OF LIFETIME OF A DOUBLED ELEMENT A. D. Solov'yev p 170–173 ref (See N65-14777 05-09)

16. ON RELIABILITY OF TWO RESERVED REPAIRED SYSTEMS WITH ONE SERVICE POINT I. P. Paderno p 174–183 refs (See N65-14778 05-09)

17. INVESTIGATION OF DYNAMICS OF A CLASS OF SELF-TUNING SYSTEMS WITH A TEST SIGNAL V. Yu. Rutkovskiy and V. N. Ssorin-Chaykov p 184–202 refs (See N65-14779 05-10)

18. MINIMIZATION OF THE STRUCTURE OF ELECTRONIC RELAY CIRCUITS BY THE METHOD OF APPROXIMATE FUNCTIONAL EXPANSION G. B. Tumanyan p 203–220 refs (See N65-14780 05-10)

19. ON A PROPERTY OF GYROSCOPIC STABILIZATION OF A CONTROLLED CONSERVATIVE MECHANICAL SYSTEM N. N. Krasovskiy p 221–232 refs (See N65-14781 05-10)

20. ON THE SOLUTION OF A PROBLEM OF CONTROL OF THE MOTION OF NON-LINEAR SYSTEMS Nguyen-Tkhan'Bang p 233–244 refs (See N65-14782 05-10)

21. STATISTICAL PROCEDURES FOR DETERMINATION OF DYNAMIC CHARACTERISTICS OF AUTOMATIC LINES N. S. Raybman p 245–262 refs (See N65-14783 05-10)

N65-14763 Joint Publications Research Service, Washington, D.C.
VARIATION IN ENTROPY OF CONTINUOUS DYNAMIC SYSTEMS
A. A. Krasovskiy *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 1–18 refs (See N65-14762 05-10) OTS: $6.00

The equation for variation of the total macroentropy of an arbitrary nonlinear dynamic system is obtained for a system which experiences the effects of random forces of excitation. The macroentropy is determined for a linear passive system with reactive relationships where the macroentropy is caused by thermal noise. For a wide class of isolated dynamic systems, constancy of the sum of the total macroentropy and so-called conditional microentropy is proved. Author

N65-14764 Joint Publications Research Service, Washington, D.C.
ON APPLICATION OF MATHEMATICAL PROGRAMMING PROCEDURES TO THE PROBLEM OF OPTIMAL CONTROL
L. S. Gnoyenskiy and S. M. Movshovich *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 19–39 refs (See N65-14762 05-10) OTS: $6.00

The problem of optimal rapid action in control systems is investigated. To find the optimal control, mathematical programing procedures are used. The number of variables, the form of limitations, and the procedures for solution of the problems encountered depend significantly on the means of approximation of the Cauchy function. Cases are considered in detail of piecewise constant and piecewise linear approximations. Basic attention is given to the development of algorithms for the solution of mathematical programing problems that are constructed. Author

N65-14765 Joint Publications Research Service, Washington, D.C.
CONSTRUCTION OF AN OPTIMAL ALGORITHM FOR EXTREMAL CONTROL ON THE BASIS OF THE PRINCIPLE OF DYNAMIC PROGRAMMING

E. A. Mozgovaya and Yu. I. Samoylenko *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 40–52 refs (See N65-14762 05-10) OTS: $6.00

The problem of optimal tracking is solved beyond the extremum in the case where a random process with independent increments is affecting an inertialess object which has the extremal characteristic. According to the procedure of dynamic planning a functional equation is constructed, the solution of which is used to construct an optimal control function. Author

N65-14766 Joint Publications Research Service, Washington, D.C.

ON THE THEORY OF APPROXIMATE SYNTHESIS OF OPTIMAL CONTROL

V. N. Kalinin *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 53–61 refs (See N65-14762 05-10) OTS: $6.00

An approximate method is investigated for synthesis of optimal control with respect to rapid action for linear objects which depend on the small parameter ϵ. Under the assumption that for equality of this parameter to zero the solution of the problem of synthesis for the initial object with corresponding form of the displaced region of control, is known, an effort is made to extend this solution to the region of nonzero values of ϵ. Values are presented for errors in the system as a function of displacement of the initial region of control. Author

N65-14770 Joint Publications Research Service, Washington, D.C.

OPTIMAL CONTROL OF A CLASS OF MULTI-RELATED SYSTEMS

O. I. Larichev *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 100–113 refs (See N65-14762 05-10) OTS: $6.00

The problem is investigated of finding optimal control for a class of systems with control relationship. An equivalent system procedure is proposed which is an algorithm for the construction of a control computing device, and this permits significant simplification of the solution of the stated problem. Author

N65-14771 Joint Publications Research Service, Washington, D.C.

ON THE PROBLEM OF ANALYTICAL CONSTRUCTION OF REGULATORS

V. N. Romanenko *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 114–122 refs (See N65-14762 05-10) OTS: $6.00

A procedure is proposed for determining the coefficients of the equation of an optimum regulator which leads, for objects having a high degree of control, to a decrease in computational difficulties when compared with procedures investigated in other papers. Author

N65-14772 Joint Publications Research Service, Washington, D.C.

SOLUTION OF A SPECIAL CASE OF THE WIENER EQUATION

M. G. Zotov *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 123–130 refs (See N66-14762 05-10) OTS: $6.00

The N. Wiener equation for the case where the desired optimal filter is located between the points of application of a useful signal and noise is investigated. To maintain the mean square error at zero, it is required that systems be formed which are stable for infinitely large coefficients of amplification, that is, which are invariant up to ϵ. Thus, the relationship of the theory of invariance to the filtration theory is known. From an investigation of the phase amplitude characteristics of the system the appropriate expresssions are introduced between the coefficients of the transfer function obtained by M. V. Meyerov with another method. It is shown that to insure a minimum mean square error it is insufficient to have just one increase in the coefficients of amplification. Author

N65-14773 Joint Publications Research Service, Washington, D.C.

ON THE DYNAMICS OF AUTOMATIC SYSTEMS OF DISCRETE CONTROL CONTAINING CONSERVATIVE OR OSCILLATING LINKS

S. M. Fedorov *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 131–141 refs (See N65-14762 05-10) OTS: $6.00

Peculiarities are investigated of stabilization of continuous systems containing conservative or weakly damped oscillating links. It is shown that by introduction of discrete (pulse) elements into the system it is possible to maintain a sufficient reserve of stability at the same time as for continuous control the system is structurally unstable. Investigation of the dynamics of the system for discrete control is carried out with the help of logarithmic frequency characteristics. Author

N65-14775 Joint Publications Research Service, Washington, D.C.

ON IDLE DOUBLING WITH REPAIR FOR ANY LAW OF DISTRIBUTION OF FLOW OF BREAKDOWNS AND TIME OF REPAIR

A. F. Zubova *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 153–158 refs (See N65-14762 05-10) OTS: $6.00

A method is proposed for determining the probability that a system consisting of a main circuit and a reserve circuit will be in operating condition after a time t. When the main circuit breaks down, the reserve circuit is placed into operation, and the time necessary for the main circuit to be repaired is τ. Two methods of investigating the probability are considered: (1) In order for the system to operate for a duration of time t it is necessary that either (a) the operating device does not break down in the time t, or (b) the operating device breaks down after the time τ but the reserve circuit functions until after time t. (2) For a trouble-free time of operation t, it is necessary that either (a) the operating device does not break down during the period of time t, or (b) the operation device breaks down at a time t_1 but the reserve circuit operates trouble-free for a time $t - \tau$, or .c) the operating device breaks down at a time T, the reserve circuit breaks down at a time $\Theta(0 \leq \tau \leq \Theta \leq t)$, but the basic main circuit has been repaired before time Θ. P.V.E.

N65-14776 Joint Publications Research Service, Washington, D.C.

ON DOUBLING WITH REPAIR

B. V. Gnedenko *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 159–169 refs (See N65-14762 05-10) OTS: $6.00

The distribution of length of trouble-free operation of a double system is found. It is proposed that the length of trouble-free operation of a device is subject to a known distribution; the repair of a broken down device means total restoration of its properties. The length of repair has an arbitrary distribution. The reserved device is in the light conditions. Two limiting theorems are proved under the assumption that the length of repair is significantly less than the length of trouble-free operation of the device. Author

N65-14779 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF DYNAMICS OF A CLASS OF SELF-TUNING SYSTEMS WITH A TEST SIGNAL
V. Yu. Rutkovskiy and V. N. Ssorin-Chaykov *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 184–202 refs (See N65-14762 05-10) OTS: $6.00

Procedures are investigated for calculation of self-tuning systems with a test sinusoidal signal maintaining constant frequency-amplitude characteristics of a closed system on one frequency. Problems are investigated of selection of the frequency of the test signal and separation of independent control circuits. On the basis of experimental data, simplified equations are obtained for a self-tuning circuit, and an investigation is conducted of the dynamics of processes of self-tuning for a stepwise law of variation of the amplification coefficient of the objects. Author

N65-14780 Joint Publications Research Service, Washington, D.C.
MINIMIZATION OF THE STRUCTURE OF ELECTRONIC RELAY CIRCUITS BY THE METHOD OF APPROXIMATE FUNCTIONAL EXPANSION
G. B. Tumanyan *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 203–220 refs (See N65-14762 05-10) OTS: $6.00

A number of properties and dependencies are investigated of disjunctively and nondisjunctively nonfactorable Boolean functions. A determinant systematic procedure for minimization of these functions is given using approximate functional expansion. Author

N65-14781 Joint Publications Research Service, Washington, D.C.
ON A PROPERTY OF GYROSCOPIC STABILIZATION OF A CONTROLLED CONSERVATIVE MECHANICAL SYSTEM
N. N. Krasovskiy *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 221–232 refs (See N65-14762 05-10) OTS: $6.00

The imposition of additional gyroscopic forces by a controlled conservative mechanical system is investigated. It is shown that this gyroscopic stabilization has common features with the well-known properties of gyroscopic stability investigated by N. G. Chevayev. It is established that characteristically unstable conservative systems on imposition of a gyroscopic effect may have only the property of stabilization of a controlling force of general nature; control by a dissipative force here must destroy stability. The effect investigated is used for control of a mechanical system with a large number of degrees of freedom where the initial construction of the object does not ensure total transfer of the effect from the control organ to all the controlled links. Author

N65-14782 Joint Publications Research Service, Washington, D.C.
ON THE SOLUTION OF A PROBLEM OF CONTROL OF THE MOTION OF NON-LINEAR SYSTEMS
Nguyen-Tkhan'bang *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 233–244 refs (See N65-14762 05-10) OTS: $6.00

An approximate method of solution of a problem of control of motion of nonlinear systems is presented. Convergence of sequential approximations is proved. The procedures are shown for use of electronic simulation devices for solution of this problem. As an application of the given method, a problem is solved concerning accelerated reduction of the gyrocompass of Anshyutets to the meridian for the presence in this device of nonlinear regenerating forces. Author

N65-14783 Joint Publications Research Service, Washington, D.C.
STATISTICAL PROCEDURES FOR DETERMINATION OF DYNAMIC CHARACTERISTICS OF AUTOMATIC LINES
N. S. Raybman *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 245–262 refs (See N65-14762 05-10) OTS: $6.00

Statistical procedures are investigated for determination of the dynamic characteristics with respect to experimental data obtained under conditions of normal operation. The determination of the characteristics is presented for one-dimensional linear object and automatic lines. The optimal characteristics are determined by the criterion of minimum of average square of deflection. Author

N65-14794# Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY OF SILICON PLANAR EPITAXIAL: TRANSISTOR (WX-4001), LOGIC GATE (WM-201), FLIP-FLOP (WM-202), AC BINARY (WM-213) Quarterly Report, Jul. 1–Sep. 30, 1964
A. T. Hamill [1964] 23 p
(Contract DA-36-039-AMC-03617(E))
(QR-5; AD-609445)

Extensive studies of assembly and lidding procedures were performed, and significant improvements in yield and reliability are expected as a result of changes in manufacturing procedures. A number of reliability tests were completed, and many additional tests were begun. Final drafts of the specifications for all devices were undertaken and are practically complete. An outline of the revised quality control manual was finalized. The most important development during the period was the institution of automatic testing of all devices on the program, using an in-house designed and built automatic test system which automatically tests all dc parameters, prints out the data, and punches a tape which can be used for computer handling of the data. Author

N65-14906 Joint Publications Research Service, Washington, D.C.
COMPENSATION OF DYNAMIC ERRORS IN A COMBINED SYSTEM OF PROGRAMMED CONTROL
A. A. Bezvikonnyy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 98–108 refs (See N65-14894 05-14) OTS: $6.00

The feasibility is analyzed of a compensation of dynamic errors in a combined system of programed control with linear variation of input action. A method of selection of the compensating circuit and its calculation are presented. Author

N65-14959# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
ROOT LOCUS ANALYSIS OF A HIGH-GAIN-LINEAR SYSTEM WITH VARIABLE COEFFICIENTS
Robert H. La Bounty (M.S. Thesis) 26 Aug. 1964 125 p refs (GSF/EE/64-1; AD-607112)

The purpose of this thesis is to develop a method of successfully applying the root locus technique to a high-gain linear system with variable coefficients. The problem was solved by establishing rules for positioning the far-out poles of such a system based on data obtained from the analysis of a high-gain system unsuccessfully designed for the X-15 aircraft. The new method is applied successfully to two different systems. The conclusion is that a highly insensitive high-gain system capable of handling large variations in the static loop sensitivity can be successfully designed. Author

N65-14992# Illinois U., Urbana. Coordinated Science Lab.
DISTRIBUTED NETWORK SYNTHESIS AND APPROXIMATION IN THE TIME DOMAIN
R. A. Rohrer, J. A. Resh, and R. A. Hoyt Jul. 1964 24 p refs
(Contract DA-28-043-AMC-00073(E))
(R-222; AD-607711) OTS: $2.00

Conditions are obtained for the realization of the best approximation to a desired time domain input–output relation by means of a distributed network of a given class. Practical constraints are considered in obtaining the optimal (one-dimensional) spatial dependence for a series R–L, shunt G–C distributed network. The general results are specialized to L–C and R–C lines. Author

N65-15076# Illinois U., Urbana. Digital Computer Lab.
TECHNICAL PROGRESS REPORT
Jul. 1964 43 p
(Contract Nonr-1834(15))
(COO-1018-1025, Pt. II; AD-607672)

CONTENTS:

1. CIRCUIT RESEARCH PROGRAM p 1–11
2. THE ILLINOIS PATTERN RECOGNITION COMPUTER: ILLIAC III p 12
3. IBM 7094-1401 SYSTEM p 13–40
4. GENERAL LABORATORY INFORMATION p 41–42

N65-15125# Stanford U., Calif. Microwave Lab.
STUDIES OF THE EFFECT OF CIRCUIT TAPERING ON TWT PERFORMANCE
C. C. Lo Griffiss AFB, N.Y., RADC, Sep. 1964 132 p refs
(Contract AF 30(602)-2575)
(RADC-TDR-64-322; AD-607731)

The main object of this research was to show that by proper tapering of the circuit characteristics of a pulsed, high-power traveling-wave amplifier, long-persisting pulse-edge oscillations could be successfully eliminated. The type of circuit taper, which appears to have several advantages over others for suppression of pulse-edge oscillations, has both the π-mode frequency increased and the phase velocity for the pass-band frequencies decreased gradually toward the output end of the tube. The effect of circuit tapering on forward-wave amplification and the effect of circuit tapering on tube efficiency were studied. Two versions of a demountable experimental tube with circuit tapering have been designed, built, and tested. The first version of the tapered tube suffered a vacuum leak, but during its short life period, it proved to have no pulse-edge oscillations in the tapered output section of the tube, although the forward-wave gain was smaller than expected. The performance of the second version of the tube was good, and no pulse-edge oscillations could be found which originated in the tapered output section. Author

N65-15224*# Sperry Rand Corp., Blue Bell, Pa. Special Devices Dept.
RESEARCH AND DEVELOPMENT IN FLUID LOGIC ELEMENTS Technical Summary Report
T. Reader Huntsville, Ala., NASA. Marshall Space Flight Center, 16 Nov. 1964 133 p refs
(Contract NAS8-11021)
(NASA-CR-60205) OTS: HC $4.00/MF $1.00

Development of multistate fluid logic elements with three or more stable states, and the mathematical concepts required for such a logic system, show that as the number of stable conditions for a fluid element increase, so do the geometric sensitivity, the power required, and the switching time. These factors also increase with pressure and flow gain. Tests show that a multioutput without memory is a powerful logic element with a capacity for high speed and an insensitivity to small geometric variations. Operation at very low Reynolds numbers should be possible, although there are insufficient quantitative data to indicate this lower limit. The multioutput with memory element was found to have one useful application, the asynchronous shift register, but was relatively slow. M.G.J.

N65-15238# Radio Corp. of America, Princeton, N.J. RCA Labs.
THEORY OF ADJUSTABLE SWITCHING NETWORKS Final Summary Report, 1 May 1961–30 Sep. 1964
S. Amarel, K. R. Kaplan, S. Y. Levy, C. V. Srinivasan, and R. O. Winder 30 Oct. 1964 21 p refs
(Contract AF 19(604)-8423)
(AFCRL-64-894; AD-609705)

The work includes (1) threshold logic—a broad treatment of various topics in the switching theory of the threshold gate, and (2) the reliability of switching networks, including triangular recursion, active error correction, and redundancy coding. This report summarizes and analyzes the results attained, giving specific references to the earlier reports issued under the contract and to related published work. Author

N65-15363*# Rensselaer Polytechnic Inst., Troy, N.Y.
OPTIMUM CONTROL WITH DESIRED INPUT PIECE-WISE CONTINUOUS
C. N. Shen and F. G. Haag [1964] 30 p refs Presented at the 1964 Joint Autom. Control Conf., Stanford, Calif., 24–26 Jun. 1964
(Grant NsG-14-59)
(NASA-CR-53189) OTS: HC $2.00/MF $0.50

A closed-form solution of the optimum control law is derived utilizing the Pontryagin maximum principle. The desired value of the input is piecewise continuous. The derivation presented for one discontinuity can be extended to any number of piecewise discontinuities. The principle of dynamic programing holds; that is, the system is optimum for the remaining time no matter what disturbance has occurred in the past. The application of the general method is shown by an example in which the optimum control law for a nuclear reactor startup is determined. Compared to the method of state variables, the closed-form solution given by the optimum control law has the advantage of being less susceptible to random noise which may be present in the instrumentation. A closed-form solution of the control law for a second-order system is derived for any reference trajectory with continuous second derivatives. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-14535*# United Aircraft Corp., Windsor, Conn. Hamilton Standard Div.
ENGINEERING STUDY AND PRELIMINARY DESIGN OF A ONE MAN PROPULSION DEVICE FOR LUNAR AND FREE-SPACE ENVIRONMENTS Mid-Point Oral Status Report
20 Jan. 1964 53 p
(Contract NAS9-2065)
(NASA-CR-60043) OTS: HC $3.00/MF $0.50

Diagrams and charts concerned with the following are presented: (1) lunar surface locomotion—lunar surface operations, one man lunar surface (OMLS) missions, propulsion in the lunar gravity field, piloting and control, and lunar surface propulsion device concepts; and (2) free-space locomotion—free-space operations, OMLS missions, navigation and piloting, propulsion in zero-g, and free-space propulsion device concepts. P.V.E.

N65-14569# Princeton U., N.J.
AN ELECTROMAGNETIC SUSPENSION SYSTEM FOR SPHERICAL MODELS IN A HYPERSONIC WIND TUNNEL
R. N. Zapata and T. Dukes Jul. 1964 83 p refs
(Contract Nonr-1858(37))
(Rept.-682; AD-605846)

The design of an electromagnetic balance for suspending spherical models in a hypersonic wind tunnel is described. An orthogonal force system, together with compensated optical sensors in three stabilizing automatic feedback loops, provides inherently uncoupled control in 3 degrees of freedom. The report contains the designs of the electromagnetic coil configuration and of the feedback loops. Author

N65-14886# Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
MBRV FEASIBILITY FLIGHT TEST PROGRAM Monthly Progress Report, 1 Oct.–31 Oct. 1964
E. H. Smith 1 Nov. 1964 20 p
(Contract AF 04(694)-520)
(MPR-8; AD-450845)

Evaluation testing of ADC assemblies continued. The interconnection module, memory module, and memory stack were tested for temperature, shock and vibration, and leak. Equipment design engineering work included fabrication and assembly of the Serial 2 computer in the MIU and back panel module. Manufacturing of the memory stack and memory modules for Serial 2 was completed, and wiring of the memory system was begun. All integrated circuit modules were completed except one. Computer power supply was completed, and the interconnection module was in final cabling. Reliability engineering completed component testing. R.E.S.

N65-14801*# MB Associates, San Ramon, Calif.
FEASIBILITY STUDY FOR DEVELOPMENT OF A HYPER-VELOCITY GUN Second Quarterly Progress Report, 14 Aug.–14 Nov. 1964
O. K. Hudson 8 Dec. 1964 29 p refs
(Contract NAS8-11204)
(NASA-CR-60119; MB-R-64-86) OTS: HC $2.00/MF $0.50

A magnetohydrodynamic rail-type accelerator is described, the Lorentz force and the limiting phenomena of ion-sputtering and high-field skin heating are analyzed, and a slow auxiliary field is proposed as a means of overcoming these limitations. Progress is reported on some of the remaining questions about the operation of the rail gun; these involve voltage measurements across the muzzle and breech, the effect of variation of barrel cross section, and voltage drop measurements of total rail current. Additions to the existing equipment of the auxiliary field rail gun are discussed. D.S.G.

N65-14840# Naval Ordnance Test Station, Pasadena, Calif. Underwater Ordnance Dept.
MORRIS DAM PROPULSION LABORATORY
D. A. Kuntz Nov. 1964 24 p
(NOTS-TP-3559; AD-609819)

The physical properties of the laboratory are described. The laboratory is used for fundamental studies, applied research, development, and testing of hydropropulsion systems and their components. Specially designed facilities are provided for tests on propellant systems, thrust and torque producing mechanisms, engines, turbines, and other associated equipment. An underwater cableway facility is used for captive tests of torpedo systems. P.V.E.

N65-14841# Naval Ordnance Test Station, Pasadena, Calif. Underwater Ordnance Dept.
MORRIS DAM BALLISTIC RANGE
D. A. Kuntz Nov. 1964 22 p
(NOTS-TP-3560; AD-609822)

Described are the Morris Dam Ballistic Range facilities, which are used in the acquisition and study of water entry data, underwater trajectory characteristics, and structural damage information on underwater and air-to-water projectiles. The operation and instrumentation of the projectile launching facilities are described for both the Variable Angle Launcher Range and the Small Caliber Ballistic Range. D.S.G.

N65-14872# Seoul National U. (South Korea).
SUBSONIC WIND TUNNEL
Mansop Hahn Repr. from Seoul U. J. (A), 13, 1963 p 33–44 refs In KOREAN; ENGLISH summary

A complete description of a subsonic wind tunnel is presented including calibration test results and characteristic test data. The tunnel is of a horizontal, closed-circuit type with power supplied by a 1200 rpm constant speed, variable pitch propeller (6 ft in diameter) driven by a 75 hp induction motor. The tunnel has been calibrated, and surveys have shown that the maximum speed is 184 mph, the maximum variation of velocity over the test section is within ±0.8% of mean without damping screens and ±0.18% with damping screens, and these values decrease as air velocity increases. The turbulence factor was determined by a turbulence sphere method. The critical Reynolds numbers for three spheres (5, 4, and 2.9 in. in diameter) were surveyed by a strain gage sting balance. The results show that turbulence factors range from 1.25 to 1.4 without damping screens and from 1.12 to ~1.25 with the screens as air velocity varies. Author

N65-14874# Toronto U. (Canada). Inst. for Aerospace Studies
ANNUAL PROGRESS REPORT FOR 1964
A. G. Boyer et al Oct. 1964 232 p refs

CONTENTS:

PROGRESS REPORT ON RESEARCH PROJECTS
1. MECHANICS OF RAREFIED GASES 21 p
2. PLASMA DYNAMICS 29 p
3. HYPERSONIC GASDYNAMICS AND BLAST WAVE PHENOMENA 48 p

4. AERODYNAMIC NOISE 19 p
5. SUBSONIC AERODYNAMICS 13 p
6. AEROSPACE FLIGHT DYNAMICS 15 p
7. MATERIALS SCIENCE AND STRUCTURES 11 p
8. UPPER ATMOSPHERIC RESEARCH 9 p
9. MOLECULAR BEAMS AND SURFACE INTERACTIONS 32 p
10. MAGNETOGASDYNAMIC POWER GENERATION—DRB 1 p
11. INDUSTRIAL AND ARCHITECTURAL AERODYNAMICS 6 p

N65-14925# Suffield Experimental Station, Ralston, Alberta (Canada).
AN ADAPTATION OF THE SHOCK TUBE TO SMOKE TRAIL PRODUCTION
F. L. Mc Callum, R. J. Miller, W. M. Mc Murtry, and W. A. Jones 25 Nov. 1964 22 p ref
(Suffield-TN-48)

This note is an evaluation of an air-fired smoke "mortar". The device is basically a small shock tube fired by a standard shock wave valve and uses commercially available smoke-producing chemicals to give well defined white smoke trails extending from the tube "muzzle" to heights exceeding 50 feet. Author

N65-15043# Argonne National Labs., Ill. Reactor Physics Div.
PRELIMINARY PHYSICS AND HEAT TRANSFER DESIGN CALCULATIONS FOR A ROCKET FUEL TEST REACTOR (RFTR)
D. R. Mac Farlane and J. T. Madell Aug. 1964 58 p refs
(Contract W-31-109-ENG-38)
(ANAL-6328) OTS: $3.00

The concept of a test facility with which to evaluate nuclear rocket fuel elements at operating conditions was investigated. The major requirement established for such a test facility was that it produce up to a maximum power density of 10 MW/l in the test section while the test reactor was limited to a power density of 2 to 2.5 MW/l. Calculations were performed to determine the characteristic of a test facility which would achieve the desired levels of power density. The dimensions, composition, power production, coolant flow, and fuel element size of the test reactor were among the characteristics of interest. The preliminary investigation showed that a test facility with the desired power density ratio was feasible, but that it produced large amounts of power. The results also indicated that optimization of the test reactor could reduce the total power without changing the power density ratio. Author

N65-15084# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NARF FACILITIES HANDBOOK
Kirtland AFB, N. Mex., AFWL, Mar. 1964 160 p
(Contract AF 33(657)-7201)
(FZK-185; AD-448049)

Analytical and experimental work performed in the areas of radiation effects, nuclear shielding, nuclear safety, and nuclear instrumentation is described in this handbook. An inventory of the facility capability and the necessary criteria needed for the possible utilization of this facility is also presented. G.G.

N65-15130# Malaker Labs., Inc., High Bridge, N.J.
KINETIC STUDY OF ROCKET EXHAUST GASES Progress Report No. 5, 1 May 1962–31 Jan. 1963
S. F. Malaker Jan. 1963 29 p
(Contract DA-30-069-ORD-2918)
(CM-103-5; AD-299714)

An apparatus was designed and fabricated for burning long propellant strands at high pressures while maintaining the point of combustion at a fixed position during burning. This was done by feeding the propellant into the combustion zone at a rate equal to the burning rate. Spectrometric and motion picture studies were made of the burning of a Hawk propellant at moderate pressures. Author

N65-15170# Brookhaven National Lab., Upton, N.Y.
BROOKHAVEN NATIONAL LABORATORY ANNUAL REPORT, JULY 1, 1963–JUNE 30, 1964
1 Jul. 1964 245 p refs *Its* Rept.-14
(Contract AT(30-2)-GEN-16)
(BNL-867(AS-18)) OTS: $6.00

CONTENTS:

PHYSICAL SCIENCES AND ENGINEERING
1. PHYSICS p 3–46
2. HIGH ENERGY ACCELERATORS p 47–59
3. INSTRUMENTATION p 60–65
4. CHEMISTRY p 66–89
5. NUCLEAR ENGINEERING p 90–113
6. APPLIED MATHEMATICS p 114–117

LIFE SCIENCES
7. BIOLOGY p 121–135
8. MEDICAL RESEARCH p 136–150

SUPPORTING ACTIVITIES
9. TECHNICAL OPERATIONS AND SERVICES p 153–169
10. ADMINISTRATION AND OPERATIONS p 170–178

N65-15186*# Oklahoma State U., Stillwater.
SPACECRAFT TEMPERATURE CONTROL BY THERMOSTATIC FINS-TEST PREPARATION Semiannual Report, 1 Jun.–1 Dec. 1964
J. A. Wiebelt, G. J. Kneissl, and C. A. Morgan [1964] 20 p refs
(Grant NsG-454)
(NASA-CR-60220) OTS: HC $1.00/MF $0.50

This report consists of a description of the test system and the test surface to be used in the evaluation of previous analytic work. A 1-square-foot brass plate was used as a base for mounting bimetallic fins. The details of construction of the finned plate are given, a picture of the completed test system is shown, and a spectral reflectance curve of the white paint coating of the base plate is displayed. The test system was analyzed thermally, and simulator test results are predicted. D.E.W.

N65-15197# Seoul National U. (South Korea).
SEOUL NATIONAL UNIVERSITY SUPERSONIC WIND TUNNEL
Mansop Hain [1962] 7 p refs In KOREAN; ENGLISH summary

The tunnel is of an intermittent type and consists of a 15-hp air compressor, 394-cu. ft. compressed-air tanks, a variable nozzle with exit area of 2 × 2 inches, a test section, a variable diffuser, 526-cu. ft. vacuum tanks and a vacuum pump. The variable nozzle is a semiflexible supersonic nozzle which offers continuous and rapid variation of Mach number in the range of 1.25 to 4, with maximum deviation of Mach number less than ±1.0% of the nominal value throughout the range. Either 2 × 2-inch constant-area test section or 2 × 4-inch enclosed free-jet test section with 3-inch schlieren windows may be connected to the nozzle. Compressed air installations allow maximum running time of 1 to 5 minutes according to Mach numbers and stagnation pressures. Reynolds number per inch at the test section ranges between 0.5 and 3.5×10^6. Two 8-inch spherical mirrors with f = 8 feet and BH-6 mercury lamp are provided for optical surveys.

Author

N65-15251*# Minnesota U., Minneapolis. Heat Transfer Lab.
AN ARC TUNNEL FACILITY FOR THE THERMAL ANALYSIS OF ANODE AND CATHODE REGIMES IN AN ELECTRIC ARC COLUMN Summary Report, Jul. 1963–Jun. 1964
E. Pfender, S. A. Wutzke, and E. R. G. Eckert Aug. 1964 88 p refs
(Contract NAS3-2595)
(NASA-CR-54080; HTL-TR-58) OTS: HC $3.00/MF $0.75

An arc tunnel test facility which permits a wide variety of parameter settings was designed and constructed. The flow uniformity in the test section was established. Experiments in an argon atmosphere disclosed two different modes of an arc with axial flow—a fluctuating mode and a steady mode. An attempt was made to explain the symptomatic behavior of the fluctuating mode. Arc characteristics for several parameter settings were determined. High speed motion pictures were used to quantitatively study both the arc characteristics and the arc's symptomatic behavior. A large number of overall energy balances were established in order to study the influence of different parameters. Some preliminary experiments in hydrogen using a cylindrical, heated tungsten anode are reported.

Author

N65-15282# Princeton U., N.J. Gas Dynamics Lab.
THE PRINCETON UNIVERSITY HIGH PRESSURE HYPERSONIC NITROGEN TUNNEL N-3. PART I: FACILITY DESCRIPTION. PART II: CALCULATION OF GAS CHARACTERISTICS AND EVALUATION OF EFFECTS OF VIBRATIONAL NON-EQUILIBRIUM. PART III: PRELIMINARY MEASUREMENTS
I. E. Vas and G. Koppenwallner Jul. 1964 110 p refs *Its* Rept.-690
(Contract AF 49(638)-1271)
(AFOSR-64-1422; AD-608586)

A hypersonic wind tunnel using nitrogen as the test fluid has been built to operate in the continuum and slip flow regimes. The free-stream Mach number in the 6 to 8-in. diam test section varies from 16 to 25 with stagnation pressures from 2000 to 5000 psia and stagnation temperatures to 3000° K. The testing time is presently limited to 25 minutes. Because of the large range of temperatures and pressures in the tunnel, the local thermodynamic properties of the gas are defined over the range of interest. For the temperatures and pressures encountered, no dissociation effects are experienced but vibrational effects must be included. A freezing criterion is developed and applied to the present nozzle configuration. For the operating conditions, it was found that the gas can be considered to be frozen during the entire expansion process. Measurements of wall static pressure and transverse pitot pressure traces were conducted in the test region generated by the conical nozzle. The effect of stagnation pressure on Mach number was found to be important, and stagnation temperature essentially unimportant.

Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-14476# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
A DISCRETE ORDINATE TECHNIQUE FOR THE LINEARIZED BOLTZMANN EQUATION WITH APPLICATION TO COUETTE FLOW
B. B. Hamel and M. Wachman Aug. 1964 50 p refs
(Contract AF 49(638)-1283)
(R64SD53; AD-604749)

A numerical method for the solution of the linearized Boltzmann equation of hard sphere molecules is developed in which approximations are made only in sense of numerical truncations. The distribution function is considered at n discrete points in velocity space, and a closed symmetric set of differential equations is developed which describe the evolution of the distribution function at each of these discrete points. The key point of the method is the approximation, by a finite sum, of the collision integral, utilizing Gauss quadrature (integration) formulas. The method is applied to the problem of linearized Couette flow of hard sphere molecules. Numerical results are obtained for the moments and for the perturbation distribution function at the discrete points.

Author

N65-14559*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYSIS OF THE PROBLEM OF TANK PRESSURIZATION DURING OUTFLOW
William H. Roudebush Washington, NASA, Jan. 1965 27 p refs
(NASA-TN-D-2585) OTS: HC $1.00/MF $0.50

A simple one-dimensional model is postulated for the problem of pressurizing a cylindrical tank containing a liquefied gas during outflow. The fluid-dynamic and heat-transfer equations are put into a form convenient for a numerical approximation. Finite difference approximations to the equations are given, and the details of a numerical solution are explained. Axial temperature distributions in the ullage gas and the tank wall are a part of the solution, as well as the amount of pressurizing gas required. Results are obtained on an IBM 7094-II computer for 19 liquid-hydrogen examples, for which experimental data are available for comparison. These cover a wide range of tank pressures, outlet flow rates, and pressurizing gas temperatures, and include helium and hydrogen as pressurizing gases. A comparison of calculated with experimental pressurant-mass requirements is made, and, where practicable, gas and wall axial temperature distributions are also compared with the data.

Author

N65-14561*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LAMINAR BOUNDARY-LAYER SEPARATION INDUCED BY FLARES ON CYLINDERS WITH HIGHLY COOLED BOUNDARY LAYERS AT A MACH NUMBER OF 15

Donald M. Kuehn Washington, NASA, Jan. 1965 32 p refs (NASA-TN-D-2610) OTS: HC $2.00/MF $0.50

Incipient separation of a laminar boundary layer was experimentally investigated on a blunted cylinder-flare configuration at zero angle-of-attack. Conical flares with various angles were tested with each of three nose shapes in air at a nominal Mach number of 15. The nose shapes included a spherical-tipped cone, a hemisphere, and a flat face. Equilibrium stagnation temperature was about 3600° R, and the surface temperature of the models was about 550° R; thus the boundary layers on all models were highly cooled. The Reynolds numbers, based on free-stream properties for equilibrium flow and on cylinder diameter, were about 2400 and 6200. Incipient separation was believed to occur at a flare angle between 35° and 40° for all three nose shapes. Author

N65-14562*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A CRITICAL EVALUATION OF METHODS FOR CALCULATING TRANSPORT COEFFICIENTS OF PARTIALLY AND FULLY IONIZED GASES

Warren F. Ahtye Washington, NASA, Jan. 1965 112 p refs (NASA-TN-D-2611) OTS: HC $4.00/MF $0.75

The basic transport coefficients of partially ionized argon were calculated by the rigorous second-order Chapman–Enskog formulation. Comparisons were made between these values and the ones calculated by existing methods of less accuracy. The latter values for the viscosity agree with those for the second-order expression within a few percent. However, values of the second-order expression for the translational thermal conductivity and for certain multicomponent diffusion coefficients are larger by 25 to 50 percent at large degrees of ionization. Values of the second-order expression for the electrical conductivity are smaller by an order of magnitude at small degrees of ionization. A comparison of the electrical conductivity values calculated by the rigorous second-order Chapman–Enskog formulation with experimental values indicates that this approach is valid for calculating electrical conductivity, and further suggests that the same approach is reasonable for calculating the translational thermal conductivity. Author

N65-14564*# National Aeronautics and Space Administration. Washington, D.C.

APPROXIMATE INTEGRATION OF THE EQUATIONS OF MOTION OF PLANE VORTEX GAS FLOW [PRIBLIZHENNOYE INTEGRIROVANIYE URAVNENIY PLOSKOGO VIKHREVOGO DVIZHENIYA GAZA]

T. I. Chukanova Dec. 1964 10 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 2, 1964 p 321–325 (NASA-TT-F-9220) OTS: HC $1.00/MF $0.50

An approximate method is given for solving problems of plane gas flow. This method is free of the restriction of small variations in entropy, i.e., more than two terms are retained in the expansion of the exact equations, with a criterion given for the number of terms to be retained, depending on the error of the terms rejected. The applicability of the method to various boundary layer problems (i.e., Cauchy, Goursat, free-surface flow, and flow past a solid wall) is illustrated in the example of the Cauchy problem. Author

N65-14578 Tennessee U., Knoxville.

A NUMERICAL SOLUTION OF VISCOUS COMPRESSIBLE FLOW IN SLENDER CHANNELS

William Allen Myers (M.S. Thesis) Jun. 1964 59 p refs (AD-605441)

Procedures and results are given for the numerical solution of viscous compressible flow in a slender channel. The results are compared with an exact solution developed through similarity. The procedures were established under the assumptions used in the similarity solution. However, care was taken to insure that the convergence would not be significantly altered if any of the assumptions were removed. Two methods, the normal implicit method and the Crank–Nicolson method, were attempted in the numerical solution. The Crank–Nicolson method was found to be superior, but the normal implicit method had the advantage of requiring less computation time since the momentum and energy equations were solved separately by two sets of (N–2) equations with (N–2) unknowns. Author

N65-14676*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REAL-GAS EFFECTS IN CRITICAL-FLOW-THROUGH NOZZLES AND TABULATED THERMODYNAMIC PROPERTIES

Robert C. Johnson Washington, NASA, Jan. 1965 133 p refs (NASA-TN-D-2565) OTS: HC $4.00/MF $1.00

The mass-flow rate for real gases passing through critical-flow nozzles was calculated. The result is presented in the form of a critical-flow factor that provides a convenient means of calculating the mass-flow rate; the variation of the critical-flow factor also provides a measure of the real-gas effects. The results include the nozzle-throat velocity, the compressibility factor, the specific heat, the specific heat ratio, the speed of sound, and the critical pressure, temperature, and density ratios. These results are tabulated as functions of upstream stagnation pressure and temperature for air, nitrogen, oxygen, normal hydrogen, parahydrogen, and steam. Real-gas effects are found to modify the conventional one-dimensional results by up to about 10% at the low-temperature and high-pressure ends of the respective ranges. Author

N65-14697# Stanford U., Calif. Div. of Engineering Mechanics

COMPUTATION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER Final Report, May 1963–Jun. 1964

Irmgard Flügge-Lotz [1964] 148 p refs
(Grant AF-AFOSR-235-63)
(AFOSR-64-1628; AD-607573)

Discussed is an investigation of second-order effects in the boundary-layer flow along bodies moving with high constant speed or standing in a field of a parallel flow of high speed. Details about the types of difference schemes, stagnation-point solutions, and the results of two-dimensional flow along a circular cylinder and of the flow along a blunted wedge are presented. P.V.E.

N65-14713# Technical Research Group, Inc., Melville, N.Y.

SURFACE PRESSURE FLUCTUATIONS PRODUCED BY BOUNDARY LAYER TURBULENCE

Sheldon Gardner Oct. 1963 38 p refs
(Contract Nonr-3208(00))
(TRG-142-TN-63-5; AD-422750)

For an incompressible flow which obeys the Navier–Stokes equations, the boundary pressure is determined by a volume integration over quadrupole sources. Three different classes

of source terms may be identified. These involve second-, third-, and fourth-order velocity correlations. The contribution of the fourth-order or turbulence–turbulence terms to the boundary-pressure cross-spectral density at high frequencies is obtained. The results show that the turbulence–turbulence boundary pressure sources are located at an effective height, and travel with an effective convection speed, both of which depend upon frequency and the shape of the mean velocity profile. At high frequencies, the pressure spectrum is found to be roughly proportional to the sixth power of the free-stream velocity, and to the inverse cube of the frequency. The nondimensional longitudinal and lateral cross-spectral density is obtained and found to be in good agreement with experiment. Author

N65-14791# Cincinnati U., Ohio.
STUDY OF BURGERS' EQUATION OF THE KINETIC THEORY FOR A REACTING GASEOUS MIXTURE
Ting Yi Li Jul. 1964 16 p refs
(Contract Nonr-2168(03))
(AE-6402; AD-608705)

A previously developed extension (Burgers, 1959) of the Boltzmann equation which adequately takes into account chemical reactions and diffusion in a realistic kinetic model of a gaseous mixture is considered. The extension is briefly described; by the use of approximation arguments the extended equation is reduced to a simplified form. The important features of the simplified equation remain consistent with the more elaborate Burgers' equation. P.V.E.

N65-14844# Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.
WAVE REFLECTION AND TRANSMISSION IN CHANNELS OF GRADUALLY VARYING DEPTH
A. T. Ippen, A. M. Z. Alam, and E. L. Bourodimos Jul. 1964 80 p refs *Its* Rept.-72
(Contract Nonr-1841(59))
(R64-31; AD-609271)

This report presents the results of a study on the reflection and transmission of water waves in a rectangular channel with transitions of linearly varying depths. Two channel sections of uniform depths are joined by sections of slopes 1:0.58, 1:2.75, and 1:16 in the three sets of experiments. Wave conditions were systematically varied to cover the range of deep-water to shallow-water waves in the deeper approach channel. The pertinent parameters considered for each slope were relative depth (ratio of upstream to downstream depth), ratio of group velocities, and wave steepness. Since a comprehensive theory does not exist, the classical small-wave amplitude theory for abrupt transitions was employed to correlate the results of the study. Comparisons with other theories developed recently were made where applicable. Author

N65-14853*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPOSITION AND THERMODYNAMIC PROPERTIES OF REACTING GAS MIXTURES UNDER HIGH PRESSURE USING THE LEWIS AND RANDALL RULE
Wayne D. Erickson and James F. Roach Washington, NASA, Jan. 1965 25 p refs
(NASA-TN-D-2600) OTS: HC $1.00/MF $0.50

A set of equations is developed from which the chemical composition and real-gas correction terms for the thermodynamic properties of a reacting gas mixture at relatively high pressure can be calculated. This method utilizes the second virial coefficients of each of the species in their pure state and employs the Lewis and Randall rule to obtain the properties of the mixture. Results based on the present approximate calculation are compared with calculations of Hilsenrath and Klein for air. It is found that the present approximate method yields essentially the same chemical composition for the mixture as was obtained by the more rigorous method at a temperature of 6000° K and pressures of about 2500 and 4500 atm. Author

N65-14863# Itek Corp., Palo Alto, Calif. Vidya Div.
AN ANALYTICAL STUDY OF A TWO-DIMENSIONAL FLOW FIELD ASSOCIATED WITH SONIC SECONDARY INJECTION INTO A SUPERSONIC STREAM
John W. Mitchell Mar. 1964 62 p refs Prepared for Thiokol Chem. Corp.
(Contract AF 04(611)-9075)
(VIDYA-9166-TN-2; AD-450742)

An analytical study was conducted of the two-dimensional flow field associated with sonic secondary injection into a supersonic stream. The experimental model consists of a two-dimensional air jet discharging from a flat plate normal to a Mach 6 free stream. Schlieren photographs of the flow and the wall pressure distribution upstream of the jet discharge were obtained. The flow field was analyzed to determine the significant features of the flow and the mechanisms involved. In the major portion of the flow, quantitative information regarding the flow properties was obtained. In the remaining portions of the flow, a qualitative description of the flow behavior is presented. The significant features of the flow field that should be investigated further were delineated. Author

N65-14879 Joint Publications Research Service, Washington, D.C.
ON THE INFLUENCE OF RAREFACTION OF SUPERSONIC FLOW ON THE BASE PRESSURE OF A ROTATING BODY
S. I. Kosterin and N.T. Belova *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 23-34 refs (See N65-14876 05-33) OTS: $3.50

The results are described of base rarefaction at the rear of a conical–cylindrical body in movement at supersonic speed in a rarefied medium $3.40 \leq M \leq 5.53$ and $533 \leq Re_L \leq 2120$, which corresponds to the transitional rate of flow. Author

N65-14888 Joint Publications Research Service, Washington, D.C.
THE FREE FLOW OF THIN FILMS OF A VISCOUS LIQUID ON A VERTICAL SURFACE
B. S. Kasimov and F. F. Zigmund *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 122–129 refs (See N65-14876 05-33) OTS: $3.50

An analytical solution is proposed for the problem of wave motion of liquid films on a nearly vertical surface. These formulas elucidate a number of experimental data. Author

N65-14934*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A STUDY OF DENSITY VARIATIONS IN FREE MOLECULAR FLOW THROUGH CYLINDRICAL DUCTS DUE TO ACCOMMODATION COEFFICIENTS
S. J. Robertson (Heat Technology Lab., Inc.) 2 Nov. 1964 51 p refs
(Contract NAS8-11558)
(NASA-TM-X-53156) OTS: HC $3.00/MF $0.50

A theoretical investigation was made of free-molecule flow through a duct of circular cross section. The molecular flux to the duct wall and exit plane was calculated along with the total flow rate through the duct. The density field was calculated at the duct exit and along the centerline for various duct-wall temperatures and thermal accommodation coefficients. It was concluded that an experimental determination of the thermal accommodation coefficient can be made by measuring the effect of the duct-wall temperature on the density field. Author

N65-14937# Los Alamos Scientific Lab., N. Mex.
THE INTEGRATED PRESSURE DROP IN TWO-PHASE, NONADIABATIC FLOW OF HYDROGEN
John R. Bartlit 14 Dec. 1964 14 p refs
(Contract W-7405-ENG-36)
(LA-3177-MS) OTS: $1.00

A method is presented which permits the use of the Lockhart–Martinelli equations to calculate frictional pressure drops for the case of two-phase, flowing hydrogen with heat addition. The method eliminates stepwise calculations. Values of the special parameters needed to do this are given. Author

N65-14960# Itek Corp., Palo Alto, Calif. Vidya Div.
THE DEVELOPMENT OF AN ANALOGY TO BLAST-WAVE THEORY FOR THE PREDICTION OF INTERACTION FORCES ASSOCIATED WITH GASEOUS SECONDARY INJECTION INTO A SUPERSONIC STREAM
Thomas J. Dahm May 1964 72 p refs Prepared for Thiokol Chem. Corp.
(Contract AF 04(611)-9075)
(Vidya-9166-TN-3; AD-450743)

A theoretical method for the prediction of interaction forces associated with secondary injection into a supersonic stream has been derived. The theory, based on an analogy to the blast-wave theory, is derived in part for the general case of injection of either gases or liquids through slots or single ports. The derivation is complete for the gaseous injection case. Certain flat plate and conical-nozzle experimental data are shown to vary identically with the parameters suggested by the theory, the experimental interaction forces being approximately one-half of ideal. For single port injection, the theory and the data yield interaction forces which increase with the three-fourths power of the secondary mass-flow rate in the range of practical side forces. The interaction forces are shown to correlate with the theory independent of the origin of these forces (upstream or downstream of the port). Author

N65-14961# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genèse (Belgium).
REFLECTED SHOCK INLET DIFFUSER IN HYPERSONIC FLOW
F. W. Lipfert Sep. 1964 39 p refs
(VKI-TN-20)

A study has been made of hypersonic flow deceleration by means of a plane oblique shock and its reflection from a flat surface. A theoretical analysis was made of an inlet diffuser using this arrangement followed by a terminal normal shock. The optimum deflection angles were found, and it is shown that the total pressure recovery through such a system of shocks is nearly the optimum for a 3-shock configuration. The optimum is given by the Oswatitsch analysis, which was extended to Mach 10. The performance of this system was checked experimentally at Mach 5.4, with the terminal normal shock simulated by an impact probe. The results agreed well with the theory; the maximum kinetic energy efficiency was 0.91. Author

N65-14980# Aerospace Corp., San Bernardino, Calif. Fluid Mechanics Dept.
WAKE RADAR CROSS SECTION OF SLENDER RE-ENTRY VEHICLES
F. L. Fernandez, J. L. Carson, and D. A. Anderson Oct. 1964 81 p refs
(Contract AF 04(695)-469)
(TDR-469(S5855-30)-1; BSD-TR-64-152; AD-450601)

A study was performed to determine the effect of various parameters on the predicted wake radar cross section of slender reentry vehicles. The effect of body size, altitude, and flow velocity was examined, and the assumptions which typify current analytical methods are reviewed. As pointed out by Eschenroeder, binary scaling seems to be a valid approximation for a large range of body sizes and ambient pressures. Working graphs, which can be used in preliminary systems design considerations, are presented. Author

N65-15051*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOW OF ELECTRONS THROUGH A NEUTRAL SCATTTERING GAS IN A THERMIONIC DIODE
Peter M. Sockol Washington, NASA [1964] 9 p refs Presented at Thermionic Conversion Specialist Conf. of the IEEE, Cleveland, 26–28 Oct. 1964
(NASA-TM-X-52069) OTS: HC $1.00/MF $0.50

The flow of electrons through a neutral scattering gas in a thermionic diode is analyzed for electron mean free paths comparable to the electrode separation. A perfect Lorentz gas with a rigid-sphere scattering cross section is assumed. The corresponding Boltzmann equation is transformed to a pure integral equation, and self-consistent-field solutions of this equation with Poisson's equation have been computed. Density and potential variations together with saturation portions of current–voltage curves are presented. Author

N65-15052*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL INVESTIGATION OF SOME IMPORTANT PARAMETERS IN THE PRESSURIZED LIQUID HYDROGEN TANK OUTFLOW PROBLEM
William H. Roudebush and David A. Mandell Washington, NASA, 1964 24 p refs Presented at the Conf. on Propellant Tank Pressurization and Stratification, Huntsville, Ala., 20–21 Jan. 1965
(NASA-TM-X-52074) OTS: HC $1.00/MF $0.50

To evaluate the relative significance of the factors which influence the amount of gas required to pressurize a cryogenic propellant tank during the outflow period, an analysis has been made of the cylindrical portion of the tank for the time period during which outflow occurs. By making certain assumptions, the problem is reduced to a one-dimensional, nonsteady, nonviscous flow of the ullage gas with heat transfer to the tank wall, and differential equations governing the transfer problem are written. The heat-transfer coefficient is supplied either by an equation relating it to fluid properties or by using appropriate experimental values. A FORTRAN IV program for the IBM 7094-II computer is used for a finite difference solution of equations. Agreement between the calculated and experimental results encourages the use of analytical methods for examining the effects of the other parameters entering the pressurization problem. M.G.J.

N65-15060* # National Aeronautics and Space Administration, Washington, D.C.

NUMERICAL METHOD FOR THE ANALYSIS OF THREE-DIMENSIONAL SUPERSONIC GAS FLOW AROUND BODIES [CHISLENNYY METOD RASCHETA PROSTRANSTVENNOGO OBTEKANIYA TEL SVERKHZVUKOVYM POTOKOM GAZA]

K. I. Babenko and G. P. Voskresnskiy Jan. 1965 17 p ref Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 1, no. 6, 1961 p 1051–1060

(NASA-TT-F-9231) OTS: HC $1.00/MF $0.50

A numerical-analytic method is given for computing the three-dimensional flow past a pointed body at supersonic velocities and nonzero (asymmetrical) angle-of-attack. Minimal restrictions are placed on the body, assuming (1) existence of a normal at every point of the surface; (2) everywhere supersonic flow velocity; and (3) attachment of the bow wave. The calculation is based on the analytical model of a Cauchy–Kovalevskaya x-hyperbolic system. Guidelines are given for evaluating the initial data in some starting plane, wherein the flow variables are assumed to be known. Sample calculations are given for a conical body, with the results presented in the form of graphs showing the flow variables as functions of the coordinates (position), cone angle, and angle-of-attack. Author

N65-15064# California U., Livermore. Lawrence Radiation Lab.

CORRESPONDING STATES AT SMALL INTERATOMIC DISTANCES

R. Norris Keeler, Berni J. Adler, and Mathias van Thiel Nov. 1964 9 p refs

(Contract W-7405-ENG-48)

(UCRL-7907, Rev. I) OTS: $1.00

The corresponding thermodynamic measurements of condensed argon and xenon undergoing single shock of up to 200 000 atm pressure started to deviate widely under further pressure increase. The lack of correspondence at the highest pressure is attributed to the electronic excitation in xenon; the properties of argon were not significantly effected because its energy gap is larger and its temperature is half of that of xenon. Resistivity of argon was 1 ohm-cm at 300 000 atm, and 100 ohm-cm at 200 000 atm with a calculated temperature of 0.9 and 0.5 eV, respectively. Xenon reached temperatures in excess of 2 eV, and the first excitation energies in the gas and solid phase were 8.4 eV. Beyond this deviation from corresponding states, as more electrons become excited, the gap narrows further, and the system must be treated from the metallic point of view. G.G.

N65-15072# Societa Italiana per il Gas, Asti (Italy). Societa Ricerche Impianti Nucleari, Milan (Italy).

USE OF RADIOACTIVE ISOTOPES FOR GASEOUS LEAK DETECTION [L'EMPLOI DES ISOTOPES RADIOACTIFS POUR DECELER LES FUITES DE GAZ]

M. Sales, F. Borelli, A. Bruna, and P. G. Caldera (Soc. Ric. Impianti Nucl.) Brussels, EURATOM, Sep. 1964 50 p refs in FRENCH; ENGLISH summary Work done in conjunction with Soc. Ric. Impianti Nucl.

(Contract EURATOM-003-62-7 IRAI)

(EUR-1645.f) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22. 186: 70 Belg. Fr.

A method of locating leaks in underground gas mains based on the use of Br^{82}-tagged methyl bromide is described. The method consists of injecting into the main a uniformly active gas mixture containing CH_3Br^{82}, and with a radiation detector finding the points where the presence of escaped radioactivity shows failures of the main. Full details of the technique are given, together with results obtained from many experiments carried out under various experimental conditions on mains put out of service. Author

N65-15075# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany). Institut für Angewandte Gasdynamik

APPROXIMATIVE THEORY FOR THE AXISYMMETRIC SUBSONIC AND SUPERSONIC FLOW ON AND NEAR COMPOSED ROCKETS WITH FINAL CROSS-SECTIONAL AREA AT THE BODY END [NAHERUNGSTHEORIE FUR DIE ACHSENSYMMETRISCHE UNTER- UND UBERSCHALLSTROMUNG AN UND NAHE VON ZUSAMMENGESETZTEN FLUGKORPERN MIT ENDLICHEM HECKQUERSCHNITT]

Friedrich Keune Jul. 1964 112 p refs In GERMAN; ENGLISH summary

(DLR-FB-64-10; DVL-303) Available from ZLDI, Munich: 27, 80 DM

An extension of linearized theories for these flows gives the influence of finite radial distances near the apex of pointed bodies of revolution. Multistage rockets are considered. The usual method of iteration for the boundary condition of prescribed body shapes demands a development of the flow in even powered series of the radial distance that is presumed small with respect to body length. The typical physical difference between the two kinds of flow results is especially distinct. A corresponding neglect of the sharp suppositions of this theory leads to the former theories of slender pointed bodies and not so slender bodies. As an example, the two first approximations of the distribution of source functions and perturbation velocity are calculated on a halfbody with added cylindrical body in both flow cases. Author

N65-15082# General Dynamics/Astronautics, San Diego, Calif.

THE BEHAVIOR OF THE MACH DISC UP TO MODERATE PRESSURE RATIOS

L. D'Attorre and F. Harshbarger Jul. 1964 29 p refs

(Contract AF 19(628)-3269; ARPA Order 363)

(GDA-DBE-64-042; AD-444089)

Experimental measurements of the size and position of the Mach disc are summarized and compared with predictions made by three techniques. Only the technique of Bowyer, D'Attorre, and Yoshihara adequately predicts the experimental results obtained for a quiescent as well as a flowing ambient, hot and cold flow, and conical and bell-shaped nozzles over a range of exit to ambient static pressure ratios up to 300. Figures are given for predicting the size and position of the Mach disc for nozzles with axial flow, an exit Mach number of 3.185, a $\gamma = 1.225$, and an ambient $\gamma = 1.4$ as a function of exit to ambient pressure ratios and over a range of ambient Mach numbers. Also the inviscid flow fields including the Mach disc are provided for a limited number of conditions. Author

N65-15087# Oklahoma State U., Stillwater. School of Mechanical Engineering

TRANSIENT BASE PRESSURE STUDY OF AN AXISYMMETRIC SUPERSONIC MISSILE FLYING HEAD-ON THROUGH A BLAST WAVE

Glen W. Zumwalt and Homer H. Tang Feb. 1964 127 p refs Prepared for Sandia Corp., Albuquerque, N. Mex.

(SBW-6)

The problem is divided into two parts: blast wave passage and postpassage transients. The relation of base pressure versus time was sought by analytical means. For the first part

of the problem, a flow model was devised for the conditions before and after the blast front passage over a slender axisymmetric missile. A solution was obtained by a transformation to a wave-attached coordinate system. For the transient conditions following the blast front, a quasi-steady approach was adopted, using time iteration. To do so, it was necessary to extend Zumwalt's conical wake method for steady flow to include mass transfer from the airstream to the separated air at the base. A wind tunnel test program was designed and data were analyzed to obtain empirical information required for effective conical jet pumping surface. Author

N65-15121# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
LOCAL BOUNDARY LAYER APPROXIMATIONS OF REGULAR FLOWS PAST A SEMI-INFINITE PLATE
E. W. Schwiderski and H. J. Lugt Oct. 1964 32 p refs
(NWL-1918; AD-609599)

This paper is concerned with regular symmetric motions of an incompressible fluid past a semi-infinite flat plate which has been immersed in a uniform parallel stream. The Navier–Stokes equations are reduced to three ordinary differential equations by local boundary layer approximations of first order. The remaining ordinary boundary value problem is numerically integrated for flows of stagnation and for wakes of various Reynolds numbers. Complete numerical results are presented in tables and figures. Author

N65-15152*# National Aeronautics and Space Administration, Washington, D.C.
THREE DIMENSIONAL FLOW AROUND BLUNT BODIES BY A SUPERSONIC STREAM OF PERFECT GAS [PROSTRANSTVENNOYE OBTEKANIYE ZATUPLENNYKH TEL SVERKHZVUKOVYM POTOKOM SOVERSHENNOGO GAZA]
Yu. N. Dyakonov Jan. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 150–153
(NASA-TT-F-299) OTS: HC $1.00/MF $0.50

A method for the numerical calculation of the supersonic flow of gas (assumed to be ideal) around spherically truncated cones by the use of grids is proposed. In the experiment, the initial surface $z = 0$ passes across a line of intersection of a sphere and a cone and a reading along the z axis is taken from this surface in units of the radius of the sphere. The results obtained approach the theoretical values except in the presence of a fine vortex layer near the surface of the body; this difficulty is also encountered with all other methods of calculation. Author

N65-15175# Hydronautics, Inc., Laurel, Md.
ON FULLY-CAVITATING HYDROFOILS ENTERING GUSTS UNDER A FREE SURFACE
C. C. Hsu Jul. 1964 26 p refs
(Contract NObs-90224)
(TR-463-5; AD-455036)

A simple linearized theory for the gust problem of a two-dimensional thin supercavitating hydrofoil is developed. General expressions are presented for the gust response function, lift and moment coefficients. It is found that, in general, the lift and moment due to gusts vary appreciably with the depth of submersion. At a depth–chord ratio of unity (typical value), the nonsteady characteristics are not well approximated by either the deeply submerged or surfaced hydrofoil results. Detailed numerical results for the case of the sinusoidal gust, based on digital machine calculation, are given. Author

N65-15204# Pennsylvania State U., University Park. Coll. of Engineering
MODIFIED HANKEL FUNCTIONS AND THEIR INTEGRALS TO ARGUMENT 10 Engineering Research Bulletin
K. Singh, J. F. Lumley, and R. Betchov Oct. 1963 35 p refs
(Contract NOrd-16597)
(B-87; AD-425594)

Solutions of Stokes' equations are used to construct asymptotic solutions of the Orr–Sommerfeld equations for analyses of the stability of laminar flows. The pertinent solutions are the second integrals of the modified Hankel functions of order one-third. The Harvard values of the modified Hankel functions were extended to an argument of ± 10, recomputing the values beyond 5.0, and the first and second integrals of the same range were determined. These new values, together with Betchov's integrals to an argument of ± 5 are presented. G.G.

N65-15213# Suffield Experimental Station, Ralston, Alberta (Canada).
FURTHER STUDIES ON SHOCK WAVE VALVES
W. A. Jones, F. L. Mc Callum, W. M. Mc Murtry, and J. C. Muirhead 29 Sep. 1964 18 p refs
(Suffield-TN-140)

The operation of shock tubes by mechanical valves, instead of frangible diaphragms, has introduced many new possibilities into the design of shock tubes. Described are studies which were conducted on the design and operation of the following shock wave valves: (1) a constant cross-section valve; (2) a 4- by 4-inch shock tube; (3) a 2 1/4-inch diameter high-pressure shock wave valve; (4) a small hand-held shock tube; (5) a mechanism for automically firing shock wave valves; and (6) experiments on solenoid-operated shock wave valves. The results of these investigations and data obtained are presented. R.R.D.

N65-15234# Polytechnic Inst. of Brooklyn, Freeport, N.Y.
LINEARIZED ANALYSIS OF UNSTEADY, REACTING FLOWS WITH BODY FORCES
Pasquale M. Sforza Sep. 1964 24 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-848; AFOSR-64-1873; AD-609574)

An investigation of the effect of body forces on a one-dimensional, unsteady flow of a reacting gas is presented. The model proposed for this study is one in which a central region of gas is perturbed from the state and flow reference values of the ambient, and the subsequent temporal and spatial variations of the imposed perturbations are studied analytically. In the present report the configuration of the perturbed region is taken to be slab-like; this corresponds to a steady two-dimensional jet- or wake-like flow. Results indicate that the effect of buoyancy forces on the velocity field is inversely proportional to the amount of energy absorbed in the chemical relaxation process. In particular, solutions for the case of very small chemical energy absorption become unbounded with time within the present approximation. Author

N65-15302# General Electric Co., Schenectady, N.Y. Research Lab.
TRANSITION OF HYPERSONIC BOUNDARY LAYER
H. T. Nagamatsu, B. C. Graber, and R. E. Sheer, Jr. Jun. 1964 39 p refs
(Rept.-64-RL-3692C)

An investigation was conducted in a hypersonic shock tunnel to study the boundary layer on a highly cooled 10° cone of 4-ft length. An impact pressure survey of the various

types of boundary layer flows was made at 34.5 in. from the cone tip. The free-stream conditions at this location for Mach number and stagnation temperature were approximately 10° and 1400° K, respectively. The tunnel-operating conditions and cone tip configurations were combined such that laminar, transition, and turbulent flows were obtained at the 34.5-in. location. The impact pressure data were reduced to velocity, temperature, and density profiles for comparison. Surface heat transfer results were also obtained at approximately 34.5 in. from the cone tip along with schlieren photographs of the boundary layers. From the velocity profiles, the local skin friction coefficient was determined for the laminar and turbulent flows, and it agreed reasonably well with the corresponding theories. Author

N65-15313# Aerospace Corp., San Bernardino, Calif. Fluid Mechanics Dept.
NONEQUILIBRIUM CONTAMINANT IONIZATION IN LAMINAR WAKES
John J. Kane 27 Aug. 1964 37 p refs
(Contract AF 04(695)-469)
(BSD-TDR-64-116; TDR-469(S5810-26)-1; AD-452726)

A solution is derived for the effects of contaminants on the centerline (peak) electron densities in the laminar wake. This solution includes diffusional effects and the effects of the initial electron profile shape. Computations are completed for representative reactions for sodium ionization and chemi-ionization. For the particular reactions considered, the electron generation in the laminar wake due to sodium contamination and chemi-ionization is evaluated and compared to the clean air ionization. Author

N65-15331*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
ANALYSIS OF AXIALLY SYMMETRIC DE LAVAL NOZZLES FOR ADIABATIC, STEADY, NONVISCOUS, ROTATIONAL, COMPRESSIBLE FLOW
J. W. Littles Oct. 1964 145 p refs
(Contract NAS8-5289)
(NASA-CR-60307; R-116) OTS: HC $4.00/MF $1.00

This report describes the revisions which have been made to an existing FORTRAN IV computer program in order to account for the rotational effects which are present downstream of a curved shock in a flow field which is originally irrotational. The revised program utilizes the axially symmetric method of characteristics for adiabatic, steady, nonviscous, rotational, supersonic, compressible flow. All of the capabilities of the original program have been preserved. Author

N65-15340# California U., Los Angeles. Molecular Beam Lab.
ROTATIONAL AND TRANSLATIONAL RELAXATION EFFECTS IN LOW-DENSITY HYPERSONIC FREE JETS
Eldon L. Knuth Nov. 1964 46 p refs
(Grant NsF GP-534)
(Rept.-64-53)

Jets formed by expansions of gases with negligible vibrational degrees of freedom from sonic orifices into vacua are examined; methods for predicting freezing points for rotational and translational degrees of freedom and centerline Mach-number distribution downstream from rotational freezing point are developed. Exemplary curves of freezing-point Mach numbers vs dimensionless freezing-point parameters (orifice diameter divided by sound speed and relaxation time at stagnation conditions) for nitrogen and argon are included. Curves relating impact pressure with Mach numbers immediately upstream from rotational freezing point and immediately upstream from the normal shock are provided. It is shown that, for a given distance from orifice to impact tube, upstream rotational freezing in a diatomic gas may increase impact pressure by as much as 21%, increase probe Reynolds number by as much as 49%, and decrease probe Knudsen number by as much as 44%. Author

N65-15388# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany). Institut für Angewandte Gasdynamik
THREE-COMPONENT-MEASUREMENTS ON THE AGARD-CALIBRATION MODEL B IN THE VERTICAL TEST SECTION OF THE BLOW-DOWN WIND-TUNNEL AT AACHEN [DREIKOMPONENTENMESSUNGEN AM AGARD-EICHMODELL B IN DER VERTIKALEN MESSTRECKE DES AACHENER UBERDRUCK-UBERSCHALLWINDKANALS]
A. Heyser and B. Fabis Oct. 1964 41 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-23, DVL-360) Available from ZLDI, München: DM 13,85

In the free-jet test section with axially symmetrical cross section of the blowdown wind tunnel, three component measurements on an AGARD calibration model B in the high subsonic (M = 0.6 to 0.90) and in the supersonic region (M = 1.57, 1.83, 2.25, and 2.80) were carried out. The comparison with results of measurements which are on hand from other wind tunnels shows an agreement with those being achieved in AEDC tunnels. Author

N65-15403*# Alabama U. Research Inst., Huntsville.
EFFECT OF GAS-SURFACE INTERACTION POTENTIAL ON ENERGY AND MOMENTUM TRANSFER IN HIGH KNUDSEN NUMBER GAS FLOW, PARTICULARLY FOR CONDENSABLE GAS MEDIA
A. B. Huang Sep. 1964 59 p refs
(Grant NsG-381)
(NASA-CR-60347; UARI-RR-10) OTS: HC $3.00/MF $0.50

This study concerns kinetics of molecules in a free-molecule flow regime under influence of strong interaction with the surface (the physical nature of gas and solid atoms). The Kirkwood-Muller potential has been used for the gas–surface interaction. Considerations include physical adsorption at the surface, energy, and momentum transfer between molecules and solid atoms. The distribution function of the trapped, diffusely re-emitted molecules is derived. A new method which allows reliable aerodynamic calculations on energy transfer without knowing the accommodation coefficient is presented. The usefulness of the method is checked with the Stalder and Jukoff calculations. The comparison between the present theory and Stalder's calculations shows that the present theory offers more reliable results with respect to various gases and solids. The significance of adsorbed layer in free molecule flow regime is explored. Aerodynamic contribution to drag on a body in free molecule flow due to adsorption at the surface is also considered. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-14493# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
ROCKET MEASUREMENTS WITH ELECTRON AND ION PROBES IN AN AURORA Environmental Research Paper No. 56
J. C. Ulwick, W. Pfister, O. C. Haycock, and K. D. Baker (Utah U.) Sep. 1964 31 p refs
(AFCRL-64-791; AD-609454)

An Aerobee rocket was fired into Class I Aurora. Data are available from the following experiments: retarding potential probes mounted on the front and side, standing-wave impedance probe on two frequencies, plasma frequency probe, plasma resonance probe, and a Langmuir probe. In addition, simultaneous measurements have been made with ionosondes, all sky cameras, photometers, spectrometers, auroral radar, riometers, and magnetometers. The rocket went through the aurora on ascent and descent at about 105 km. Density values were measured at this altitude about 2.5×10^5 per cm^3. This is about a factor of 10 more than that measured at the peak altitude of 228 km. The data are relatively smooth with little of the irregularities expected in an aurora. Author

N65-14510# Defence Research Board, Ottawa (Canada).
COAST EFFECT OBSERVED IN THE POSITIONS AND ORIENTATIONS OF AURORAL ARCS
Nov. 1964 16 p Transl. into ENGLISH of two Russian papers
(T-403-R)

CONTENTS:

1. GEOGRAPHICAL DISTRIBUTION OF STABLE AURORAL FORMS IN THE REGION OF TIKSI BAY D. P. Duma p 1–4 refs (See N65-14511 05-13)

2. SOME QUESTIONS OF LOCAL GEOGRAPHIC DISTRIBUTION AND DYNAMICS OF THE AURORA Ye. A. Ponomarev and I. A. Rudenko p 5–8 refs (See N65-14512 05-13)

N65-14511 Defence Research Board, Ottawa (Canada).
GEOGRAPHICAL DISTRIBUTION OF STABLE AURORAL FORMS IN THE REGION OF TIKSI BAY
D. P. Duma *In its* Coast Effect Observed in the Positions and Orientations of Auroral Arcs Nov. 1964 p 1–4 refs Transl. into ENGLISH from IGY Bull. (Kiev), no. 3, 1961 p 30–33 (See N65-14510 05-13)

Reported are the results of research on the geographic positioning of homogeneous arcs and rayed arcs in the region of Tiksi Bay for the period from October 1957 through March 1958. A short account is given of some features of auroral behavior over the continent and over water-bodies, and it is pointed out that there exist "forbidden regions" where the aurora is not observed in the zenith, and that there is a "coast effect," some arcs assuming the shape of the coastline. Author

N65-14512 Defence Research Board, Ottawa (Canada).
SOME QUESTIONS OF LOCAL GEOGRAPHIC DISTRIBUTION AND DYNAMICS OF THE AURORA
Ye. A. Ponomarev and I. A. Rudenko *In its* Coast Effect Observed in the Positions and Orientations of Auroral Arcs Nov. 1964 p 5–8 refs Transl. into ENGLISH from Sb. Rabot po Mezhdunarodnomu Geofiz. Godu (Kiev), no. 2, 1963 p 90–97 (See N65-14510 05-13)

To study auroral luminescence distribution with respect to coastlines, a chart of the earth's surface in the Tiksi Bay region was worked out mathematically to correspond to the visual field of the C-180 camera, and distorted in conformity with its mirror-optical system. Geographical points representing shore contours were marked with the camera site taken as center, the azimuth and distance of each location were calculated, and magnetic parallels and meridians were plotted. Some 60 000 film frames, taken of the region, were projected onto the chart and examined. Movements of different auroral forms and the transition of one form into another were followed, and brightness variations in the aurora development process were estimated. Auroral forms studied included the rayed arc and arc with diffuse luminescense between the rays; the homogeneous arc and its ray structure; and diffuse glow. It was concluded that the underlying surface influences aurora development, and that the magnetic field effect on auroral arc direction varies for different forms, particularly for weak homogeneous arcs. M.G.J.

N65-14613*# Consultants and Designers, Inc., Arlington, Va.
METHOD OF DETERMINATION OF ELECTRON CONCENTRATION PROFILE ABOVE THE F-LAYER MAXIMUM ACCORDING TO GROUND MEASUREMENT DATA [METOD OPREDELENIYA PROFILYA ELEKTRONNOY KONTSETRATSII VYSHE MAKSIMUMA OBLASTI F PO DANNYM IZMERENIYA S POVERKHNOSTI ZEMLI]
S. A. Namazov 11 Dec. 1964 10 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 11, 1964 p 1933–1937
(Contract NAS5-3760)
(NASA-TT-F-9609; ST-AI-10258) OTS: HC $1.00/MF $0.50

A method is described for the determination of the electron concentration profile above the F-layer maximum according to data on vertical sounding of the ionosphere from the earth's surface, and also by measurement data of integral concentration of electrons above the maximum. It is assumed, at the same time, that the height of uniform atmosphere (H) in the region above the maximum varies linearly as a function of the altitude h. Author

N65-14622*# Consultants and Designers, Inc., Arlington, Va.
MEASUREMENT OF ATMOSPHERE DENSITY IN THE 50 TO 70 KM ALTITUDE RANGE [IZMERENIYE PLOTNOSTI ATMOSFERY V INTERVALE VYSOT 50–70 KM]
Yu. A. Bragin 4 Jan. 1964 6 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, 1964 p 917–919
(Contract NAS5-3760)
(NASA-TT-F-9622; ST-AM-10272) OTS: HC $1.00/MF $0.50

The results of a rocket experiment for the measurement of mesosphere density by means of an ion densimeter are presented. In this densimeter, the lithium ions, sounding the atmosphere medium, are introduced into the feebly disturbed atmosphere medium ahead of the rocket's nose cone. Author

N65-14654*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
[AN EXPERIMENTAL INVESTIGATION OF THE TERRESTRIAL ATMOSPHERE UTILIZING BALLOON-BORNE MILLIMETER RADIOMETERS] Final Report, 1 Nov.–30 Jun. 1963
Alan H. Barrett 15 Jul. 1963 16 p
(Grant NsG-264-62)
(NASA-CR-50928) OTS: HC $1.00/MF $0.50

The theoretical development of thermal emission from molecular oxygen in the atmosphere indicates that study of

the resonance lines offers a means of probing the physical structure of the atmosphere. To provide experimental verification, effort was directed toward constructing a radiometer suitable for balloon flight. The radiometer system designed and built is described. Also, the results computed for the molecular oxygen emission at 30 km for various zenith angles are reported. E.E.B.

N65-14683# National Observatory of Athens (Greece). Ionospheric Inst.
IONOSPHERIC OBSERVATIONS, SCARAMANGA STATION
Oct. 1964 29 p In ENGLISH and GREEK

Tabular data and plots of ionospheric observations, recorded at the Skaramanga station, Greece, during October 1964, are presented. Measurements are made on usual days every minute, and on regular and special world days, every 1, 15, 30, and 45 minutes. An automatic ionospheric recorder, covering the frequency band 1 to 20 mc/s logarithmic sweeping of 30 sec or 3 min, is used. M.G.J.

N65-14684# National Observatory of Athens (Greece). Ionospheric Inst.
IONOSPHERIC OBSERVATIONS, SCARAMANGA STATION
Nov. 1962 26 p In ENGLISH and GREEK

Tabular data and plots of ionospheric observations, recorded at the Skaramanga station, Greece, during November 1962, are presented. Measurements are made on usual days every minute, and on regular and special world days, every 1, 15, 30, and 45 minutes. An automatic ionosphere recorder, covering the frequency band 1 to 20 mc/s logarithmic sweeping of 30 sec or 3 min, is used. M.G.J.

N65-14703# Defence Research Board, Ottawa (Canada). Telecommunications Establishment
ALOUETTE I, IONOSPHERIC DATA N(h), VOLUME I, NUMBER I
H. Beach, V. Symons, E. Dalgity, E. Elliott, C. A. Brazeau et al [1962] 413 p

Tabulations of electron number density profiles for several groups of ionograms were obtained and are listed in their recording order. A lamination method of analysis was used that assumed a linear change of the plasma frequency with height within each lamination. The matrix elements for this method were calculated from the dip angle and the gyrofrequency corresponding to the location of the satellite at the time of the sounding. G.G.

N65-14824# Naval Research Lab., Washington, D.C. Chemistry Div.
FILTER PACK TECHNIQUE FOR CLASSIFYING RADIOACTIVE AEROSOLS BY PARTICLE SIZE. PART 2: ISOTOPIC FRACTIONATION WITH PARTICLE SIZE Interim Report
L. B. Lockhart, Jr., R. L. Patterson, Jr., and A. W. Saunders, Jr. 28 Oct. 1964 13 p refs
(NRL-6164; AD-608720)

An evaluation of the relative distribution of some long-lived airborne fission products among several ranges of particle sizes was carried out by the radiochemical analysis of individual air filters exposed in a pack. The relative quantitites of radioactivity deposited on each of the filters in the packs were found to vary considerably throughout 1963; however, each of the individual isotopes behaves in much the same manner so that the fractionation of isotopes relative to one another is slight. Though isotopic fractionation by filters of different characteristics was found to be of great significance, there are indications that a more sensitive separating procedure may show more differences between particles in the extreme size ranges. The observed differences have been small and variable, rather than organized, but the variations are too large to be accounted for by experimental error. The long-lived natural radioisotope Pb^{210} has a distribution very similar to that of the fission products, but with some preferential concentration in the smaller size range. The differences are not sufficient to invalidate the use of collections made on less than perfect filters for estimating the relative fission product concentrations in the air or for the approximate age determination of bomb debris. Author

N65-14842# McGill U., Montreal (Canada). Arctic Meteorology Research Group
ATMOSPHERIC ENERGY ADVECTION IN THE ARCTIC Scientific Report No. 13
E. Vowinckel Dec. 1964 25 p refs *Its* Publ. in Meteorology No. 71
(Contract AF 19(604)-7415)
(AFCRL-64-947; AD-609181)

The Arctic has a strongly negative radiation balance during most of the year. Part of the required energy import is fulfilled by the ocean currents, and the remainder by atmospheric advection. In the present investigation a method was used whereby the net heat import was determined directly from the quantity of energy released. The advection of latent heat was calculated by determining precipitation, evaporation, and change in storage of atmospheric water vapor. The various terms and the calculated values for advected latent heat are given in tables for different areas of the Arctic Ocean and in illustrations for the two extreme areas. Apart from a very short spell in fall, the advection of latent heat is always positive in the Polar Ocean, contributing as much as 65% of the annual precipation. Only 12% of the annual precipitation is contributed by advection in the Norwegian Barents Sea. The net sensible heat advection is given by the energy balance equation for the atmosphere. Author

N65-14855*# Consultants and Designers, Inc., Arlington, Va.
LEADING SHOCK WAVE AHEAD OF THE EARTH AND ITS EFFECT ON RADIATION BELTS [GOLOVNAYA UDARNAYA VOLNA VPEREDI ZEMLI I YEYE VLIYANIYE NA RADIA TSONNYYE POYASA]
M. A. Gintsburg Jan. 1964 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 3, no. 6 p 1127-1128
(Contract NAS5-2078)
(NASA-TT-F-8667; ST-PF-10105) OTS: HC $1.00/MF $0.50

A previous discussion on the Pioneer I experiment resulted in a conclusion that the width of magnetic field pulses, fixed in the experiment between 12 and 14 Earth radii, exceeded that of an isolated pulse according to Adlam and Allen theory by two or three orders. With the assumption that the theoretical width of the pulse would be $d = 4c/\omega_0$ (ω_0 being the plasma frequency), the rate of such a pulse would be much lower than the Alfven velocity, which constitutes a paradox. In the present article, an attempt is made to resolve this paradox. It is suggested that the system of pulses at the distance measured by Pioneer I and Pioneer V are nothing more than a front of a collisionless leading shock wave and that this front would be stationary relative to the Earth but mobile relative to solar corpuscular stream plasma with a velocity

$u = (3 - 5) \times 10^7$ cm/sec. Thus when computing the pulse width d, it is necessary to multiply its duration by the speed of the rocket. P.V.E.

N65-14868# Weather Bureau, Washington, D.C.
PROCEEDINGS OF SYMPOSIUM ON SPACE "WEATHER", HELD AT AIRLIE HOUSE, WARRENTON, VIRGINIA, 2–4 APRIL 1964
Laurence H. Clark ed. Jul. 1964 669 p refs
(AD-607644) OTS: $11.45

In this symposium, "space weather" refers to the properties and conditions of the outer regions of the earth's atmosphere (above about 15 km where extraterrestrial effects may assume importance) and also of interplanetary space which require systematic monitoring because of their variability. "Space weather" also considers the energetic particle and solar ultraviolet and X-ray radiation, insofar as their effects on the medium and on space vehicles and their contents and their missions are concerned. Papers were presented on space missions, informational background on the earth's environment, and present and planned programs of Government agencies for the generation, collection, and processing of data. Working sessions were also held to examine the needs of each discipline. M.G.J.

N65-14869# Denver U., Colo.
A METHOD FOR CHOOSING MEANINGFUL TEST AREAS
Thomas M. Griffiths Feb. 1964 21 p refs *Its* Tech. Paper 64-6
(AD-450595)

The problem of choosing meaningful test areas for environmental studies is presented, and the concept of a real differential is examined. The unit area method of classifying phenomena was applied to the categories of climate, terrain, and natural vegetation. By examining the synthesis of three types of terrain, five types of climate, and three types of natural vegetation, 18 natural environment unit areas were delimited for North America. These areas and sites are suggested for future testing of environmental classification hypotheses. The system described in this study could be expanded to include the whole land surface of the earth. R.R.D.

N65-14926# Raytheon Co., Norwood, Mass.
INVESTIGATIONS OF ELECTRICAL CHARACTERISTICS OF THE SUBSURFACE ROCK MEDIUM IN ESSEX COUNTY, NEW YORK Scientific Report No. 5
Carson K. H. Tsao Aug. 1964 33 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-731; AD-609683)

Average conductivities in two vertical drill holes were deduced from input impedance of bare monopole antennas placed in the hole. Detailed variations in conductivity with depth in the hole were deduced from short probe measurements. Transmission tests were made between the two drill holes which are separated by a distance of 2.8 miles. In the elf and vlf region, transmission of signals was through the rock path between the drill holes. As frequency was increased from the upper region of the vlf band to the mid lf band, the up-over-down mode of propagation became dominant. Where propagation was attributed to the path through the rock, the measured values of mutual impedances between the antennas in the holes were used to deduce the bulk conductivity of the rock path. Measurements of atmospheric noise were also made at one drill hole site to evaluate the refraction loss at the earth–air interface. Author

N65-14927# Pennsylvania State U., University Park. Ionosphere Research Lab.
IONOSPHERIC PROCESSES AND NITRIC OXIDE Scientific Report No. 228
Marcel Nicolet 20 Dec. 1964 33 p refs
(Contract AF 19(628)-4014; NSF GP-2914)
(AFCRL-64-948; AD-609844)

Analysis of ionic processes in the ionosphere leads to the conclusion that nitric oxide and its ion are produced by a reaction between nitrogen molecules and molecular oxygen ions. Such a process implies a substantial increase of nitric oxide in the E-layer to a value greater than the photochemical concentration. In the lower D-region, N_2^+ and O_2^+ ions produced by cosmic rays are transformed into NO^+ ions. A quantitative estimate shows that these conclusions are consistent with observational data in the chemosphere and ionosphere and also suggests the explanation of the night airglow continuum. Author

N65-14954*# New Hampsire U., Durham.
STRUCTURE OF THE EARTH'S MAGNETOPAUSE
Bengt U. O. Sonnerup (Royal Inst. of Tech., Stockholm) and Laurence J. Cahill, Jr. [1964] 31 p refs
(Contract NASw-155; Grant NsG-624)
(NASA-CR-60163; UNH-64-12) OTS: HC $2.00/MF $0.50

Five Explorer 12 magnetometer records are examined with the objective of deciding whether the terrestrial magnetic-field lines on the sunlit side of the magnetosphere reach into interplanetary space. It is shown how the data can be used to determine the vector normal to the magnetopause surface. The field component along this normal vector is computed. In three cases, all occurring during magnetic-storm main phases, normal-field components of 7-8 γ are found, which cannot readily be explained by experimental errors. Of the two remaining cases, occurring during magnetically quiet conditions, one was inconclusive and the other showed an insignificantly small normal-field component. The measured normal vector is found to deviate substantially from theoretical predictions suggesting waves or local bumps in the magnetopause surface. Author

N65-14965# Defence Research Board, Ottawa (Canada).
LARGE-SCALE GEOMAGNETIC FEATURES IN THE REGION OF TRANSITION FROM THE ASIATIC CONTINENT TO THE PACIFIC OCEAN
O. N. Solov'yev, A. G. Gainanov, B. A. Andreyev, and L. A. Rivosh Jun. 1964 64 p refs Transl. into ENGLISH from RUSSIAN
(T-397-R; AD-450222)

CONTENTS:

1. FEATURES OF DEEP GEOLOGICAL STRUCTURE IN THE ZONE OF TRANSITION FROM THE ASIATIC CONTINENT TO THE PACIFIC OCEAN IN THE REGION OF THE KURILE-KAMCHATKA ISLAND ARC O. N. Solov'yev and A. G. Gainanov p 1–11 refs
2. GEOPHYSICAL AND GEOLOGICAL FEATURES OF THE NORTHWEST PACIFIC ZONE OF DEEP-FOCUS EARTHQUAKES B. A. Andreyev p 13–16 refs
3. SOME GEOPHYSICAL DATA ON THE DEEP GEOLOGICAL STRUCTURE OF THE CENTRAL KAMCHATKA DEPRESSION L. A. Rivosh p 17–26 refs

N65-14969# Pennsylvania State U., University Park. Ionosphere Research Lab.
NITROGEN OXIDES IN THE CHEMOSPHERE Scientific Report No. 227
Marcel Nicolet 10 Dec. 1964 34 p refs
(Contract AF 19(628)-4014; Grant NSF GP-2914)
(AFCRL-64-939; AD-609943)

A study is made of the various reactions in which nitrogen oxides are involved in the chemosphere. The hydrogen compounds do not play an important role, and it is found that the essential aeronomic reactions depend on ozone and atomic oxygen. Thus, the ratio of nitrogen dioxide to nitric oxide can be determined. The absolute values of the NO_2 and NO concentrations depend on the dissociation of molecular nitrogen in the chemosphere. The chemical conditions cannot be applied in the mesosphere since the lifetime of NO is relatively long, and a downward transport is involved. Very special assumptions concerning chemical reactions would be necessary to reconcile the photochemical picture and the observational results. Author

N65-15007# Northeastern U., Boston, Mass.
RESEARCH ON AIRGLOW PHENOMENA USING INSTRUMENTATION TECHNIQUES Final Report
Louis J. Nardone, ed. 10 Apr. 1964 70 p
(Contract AF 19(604)-7307)
(AFCRL-64-343; AD-607762)

In support of the upper atmosphere research program, work was conducted on the design, construction, and testing of instrumentation for the study of day and night airglow phenomena. Descriptions are given of rocketborne instruments used for the measurement of day airglow. For daytime emissions, preliminary results indicate intensities of 500 rayleighs for the 5577Å [OI] line, 1.5 kilorayleighs for the 5893Å [NaI] doublet, and less than 2 kilorayleighs for the 6300Å [OI] line. Description is given of a portable, battery-operated filter photometer for the measurement of night airglow emissions. In the case of both day and night airglow photometers, the required calibration procedures were developed, along with the design and development of the instruments. A procedure for performing the calibrations and a description of the optical darkroom facility are given. Author

N65-15033# Joint Publications Research Service, Washington, D.C.
PROBLEMS OF ATMOSPHERIC DIFFUSION AND AIR POLLUTION
M. Ye. Berlyand et al 18 Jan. 1965 167 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 158, 1964 p 3–135
(JPRS-28343; TT-65-30148) OTS: $5.00

CONTENTS:

1. ON COMPUTING ATMOSPHERIC POLLUTION BY DISCHARGES FROM THE STACKS OF POWER PLANTS M. Ye. Berlyand, Ye. L. Genikhovich, and R. I. Onikul p 1–27 refs

2. A NUMERICAL INVESTIGATION OF ATMOSPHERIC DIFFUSION DURING NORMAL AND ANOMALOUS STRATIFICATION CONDITIONS M. Ye. Berlyand, Ye. L. Genikhovich, V. P. Lozhkina, and R. I. Onikul p 28–39 refs

3. PECULIARITIES OF DIFFUSION FOR A HEAVY CONTAMINANT IN THE ATMOSPHERE M. Ye. Berlyand, Ye. L. Genikhovich, V. P. Lozhkina, and R. I. Onikul p 40–51 refs

4. ON COMPUTATIONS OF THE TURBULENT EXCHANGE COEFFICIENT BASED ON GRADIENT DATA G. P. Rastorguyeva p 52–57 refs

5. THE EFFECT OF RELIEF ON THE WIND VELOCITY AND TURBULENT EXCHANGE IN THE SURFACE LAYER OF AIR I. I. Solomatina p 58–66 refs

6. SOME PROBLEMS OF AEROLOGICAL OBSERVATIONS IN INVESTIGATIONS OF THE PROPAGATION OF SMOKE PLUMES P. A. Vorontsov p 67–84 refs

7. METHODS OF AEROLOGICAL OBSERVATIONS FOR STUDYING THE PROPAGATION OF CONTAMINANTS FROM SMOKE STACKS M. A. Belyashova, I. V. Vasil'chenko, D. A. Konovalov, S. I. Maslov, and I. I. Chestnaya p 85–96 refs

8. METHODS AND SOME RESULTS OF AN INVESTIGATION OF TURBULENT EXCHANGE IN THE BOUNDARY LAYER OF THE ATMOSPHERE, MADE WITH AN AIRCRAFT P. A. Vorontsov, M. A. German, and A. S. Dubov p 97–105 refs

9. DISTRIBUTION OF SURFACE CONCENTRATIONS OF SULFUR DIOXIDE AND ASH IN THE ZONE OF A THERMAL POWER PLANT B. V. Rikhter, R. S. Gil'denskiol'd, and V. M. Styazhkin p 106–110 refs

10. SOME DATA ON THE DISTRIBUTION OF CONDENSATION NUCLEI IN THE REGION OF THE SHCHEKINSKAYA STATE REGIONAL POWER PLANT M. A. Belyashova p 111–119 refs

11. A COMPILATION OF RESULTS OF OBSERVATIONS OF ATMOSPHERIC FALLOUT USING VARIOUS COLLECTORS N. N. Aleksandrov, V. G. Kovalenko, and G. A. Panfilova p 120–129 refs

12. ON THE USE OF COUNTING RADIOMETERS V. G. Bogdanov p 130–136 refs

13. A COMPARATIVE CHARACTERIZATION OF METHODS OF SELECTING SAMPLES FOR DETERMINING THE RADIOACTIVITY OF SETTLING DUST N. M. Tomson p 137–145

14. ON EVALUATING THE SENSITIVITY OF SOUNDING RADIATION METERS A. F. Kuzenkov p 146–152 refs

15. ON DIRECT MEASUREMENT OF β-ACTIVITY OF THE AIR N. N. Aleksandrov p 153–163 refs

N65-15034# Joint Publications Research Service, Washington, D.C.
PECULIARITIES OF THE TEMPERATURE REGIME OF THE 25–50-KM LAYER
L. A. Ryazanova 21 Jan. 1965 12 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 52, 1964 p 60–66
(JPRS-28382; TT-65-30164) OTS: $1.00

An analysis of rocket sounding data has been made to determine the temperature profile of the two sublayers found in the 25- to 50-km atmospheric layer. These findings, as applied to the polar (80° to 60°) and temperate (60° to 40°) zones, led to the following conclusions: (1) Temperature field of the stratosphere in the 80° to 40° latitude range and the 25- to 50-km layer is divided into two sublayers, based on diurnal and annual variation. (2) Short-period temperature changes are caused mainly by nonradiation factors. (3) Annual temperature changes in both latitude zones usually correspond to annual variation of the radiation balance. (4) Maximum amplitude values of annual temperature variations are observed in the 30- to 40-km layer. With an increase of latitude from 50° to 80°, layer of amplitude values gradually descends from 40 to 30 km. M.G.J.

N65-15035# Joint Publications Research Service, Washington, D.C.
ON THE ESTIMATION OF REGIONAL CORRECTIONS TO THE MEDIAN HODOGRAPH
O. F. Berezhnova 22 Jan. 1965 8 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 9, Sep. 1964 p 112–115
(JPRS-28403; TT-65-30178) OTS: $1.00

The significance of regional corrections to the median hodograph was studied through observations of pairs of seismic stations from data compiled for 127 earthquakes of various epicentral zones. For each station in the pair, the epicentral distance was calculated according to the coordinates of the epicenter, the running times of longitudinal waves determined by a hodograph, and the value of the focal time established. Only moments of clearly defined arrivals of longitudinal waves were used in the calculations. Comparisons of ΔT as a function of epicentral distance for earthquakes in a northeastern, southeastern, and western direction led to the conclusion that the introduction of regional corrections to the median hodograph is not feasible. M.G.J.

N65-15055*# National Aeronautics and Space Administration, Washington, D.C.
MATHEMATICAL DEVELOPMENTS CONCERNING THE GENERAL THEORY OF TERRESTRIAL MAGNETISM
Adolf Schmidt Jan. 1965 65 p refs Transl. into ENGLISH from Arch. Deut. Seewarte (Hamburg), v. 12, no. 3, 1889
(NASA-TT-F-8753) OTS: $3.00/MF $0.75

Development of the general formulas representing the potential and the components of the geomagnetic force, and an analytical representation of the earth's magnetic state on the basis of observations are given. Results are represented by three functions: (1) the potential of the magnetic masses or closed galvanic currents within the earth's surface; (2) the potential of the same effective causes outside it; and (3) the intensity of those currents that go over from one of these two areas in space into the other. It is felt that these functions summarize all known data on the causes of magnetic forces observed on the surface of the earth, since the empirical bases are limited to magnetic measurements in this surface. M.G.J.

N65-15056*# National Aeronautics and Space Administration, Washington, D.C.
COMMUNICATIONS REGARDING A NEW CALCULATION OF THE TERRESTRIAL MAGNETIC POTENTIAL
Adolf Schmidt Jan. 1965 79 p refs Transl. into ENGLISH from Abhandl. Bayer. Akad. Wiss., Math.-Physik. Kl. (Munich), v. 19, sect. I, 1896
(NASA-TT-F-8754) OTS: HC $3.00/MF $0.75

Presented is the problem of an analytical description of the distribution of the geomagnetic power on the surface of the earth that will be free of any physical hypothesis and whose precision can be increased at will, because it will depend solely on the certainty of the data observed and on the extension of the progressions used. The final solution to this problem is the physical explanation of the geomagnetic phenomena. It is indicated that future research in this area must consider the geomagnetic phenomena as one unified phenomenon and treat it as the most urgent problem. R.R.D.

N65-15079# Joint Publications Research Service, Washington, D.C.
CLASSIFICATION OF ATMOSPHERIC TEMPERATURE STRATIFICATION TO HEIGHTS OF 45 KM
Yu. V. Kurilova and I. A. Khvostikov 21 Jan. 1965 13 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 52, 1964 p 53–59
(JPRS-28384; TT-65-30166) OTS: $1.00

Rocket measurements of the temperature to heights of 45 km were made in the northern and southern polar regions and temperate latitudes, and in tropical regions. The stratification curves for the extratropical latitudes consisted of three layers of different sign and magnitude: the troposphere and the upper and lower stratosphere. The principal differences between the tropical and extratropical stratification curves were in the heights of inflection and in the large values of the gradients in the two lower layers. Stratification, characterized by the onset of a weak inversion directly from the tropopause, was usually observed in the polar latitudes and in the temperate latitudes. A clear seasonal variation of stratification types was observed only in the polar latitudes. At identical latitudes in the Northern and Southern Hemisphere, in general, there are identical types. P.V.E.

N65-15090# Joint Publications Research Service, Washington, D.C.
STRATOSPERIC RESEARCH IN THE USSR USING METEOROLOGICAL ROCKETS DURING THE INTERNATIONAL GEOPHYSICAL YEAR AND THE INTERNATIONAL GEOPHYSICAL COOPERATION PERIOD
I. A. Khvostikov 21 Jan. 1965 6 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 52, 1964 p 3–5
(JPRS-28383; TT-65-30165) OTS: $1.00

A brief literature survey on stratospheric research in the U.S.S.R. is given. The first group of articles contains complete tables of all rocket measurements during the IGY period, which give the values of temperature and pressure measured at 1-km intervals, the heights of the principal isobaric surfaces, and the temperature at these surfaces. The second group of articles describes temperature stratification of the atmosphere, temperature regime of the 25-to 50-km layer, and sudden warming of the Arctic stratosphere. M.G.J.

N65-15093 Alberta U., Edmonton (Canada).
SOME SPECTRAL COMPUTATION EXPERIMENTS
K. Vozoff and R. M. Ellis [1963] 35 p refs
(Contract Nonr-4072(00))
(AD-604417)

The relative accuracy of computed power spectra is studied by examining spectral ratios from related signals. These ratios should be smooth functions of frequency, and their expected values are known to within a factor of 2 or 3. Attempts are made to improve the ratios by removing linear trends and by prewhitening the input signals. Two different spectral windows, Hanning and Daniell, are compared. The effect of small relative time shifts between signals is also examined. The relation of these same factors to computed coherency is also studied. It was found that prewhitening always smoothed the ratios, extended the frequency range over which they were useful, and enhanced coherency. Trend removal sometimes leads to a deterioration in these factors. Neither of the two windows is consistently better; the Daniell, however, is more satisfactory because its estimates are always positive and its coherencies always seem significant. Author

N65-15156 Consultants and Designers, Inc., Arlington, Va.
THE SPECTRAL COMPOSITION OF THE NIGHT SKY GLOW EMISSION IN A CONTINUOUS SPECTRUM AND PHOTOELECTRIC OBSERVATION OF INTENSITY VARIATIONS OF (01) 5577 AND NaD EMISSIONS [O SPEKTRAL'NOM SOSTAVE IZLUCHENIYA NOCHNOGO NEBA V NEPRERYVNOM SPEKTRE I FOTOELEKTRICHESKIKH NABLYUDENIYAKH VARIATSIY INTENSIVNOSTEY EMISSIY (01) 5577 I NaD]
V. M. Morozov 12 Jun. 1964 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 14, 1964 p 604–614
(Contract NAS5-2078)
(NASA-TT-F-8908; ST-AA-10154) OTS: HC $1.00/MF $0.50

Considered in this paper are the latest experimental data on the spectral composition of the night-sky airglow emission in a continuous spectrum and the several sources of errors in photoelectric observations of emissions [OI] 5577 and Na *D* intensity variations. It is shown that the errors that may be linked with the inconstancy of emission's spectral composition in a continuous spectrum, exert no significant effect on the variations of emissions' [OI] 5577 and 5893 Å Na *D* intensities registered during photoelectric observations. Author

N65-15160*# Consultants and Designers, Inc., Arlington, Va.
FORMATION OF IONS IN THE IONOSPHERE [OBRAZOVANIYE IONOV V IONOSFERE]
A. D. Danilov 6 Jan. 1965 26 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, 1964 p 865–880
(Contract NAS5-3760)
(NASA-TT-F-9623; ST-AI-10269) OTS: HC $2.00/MF $0.50

The questions of ion formations in the ionosphere, at heights from 100 to 200 km, are considered. On the basis of comparison of the effectiveness of various processes, basic ways are ascertained for the formation of every ion. The computation of equilibrium concentrations of ions O^+, NO^+, O_2^+, and N_2^+ for different zenithal angles of the sun is presented. It is shown that the altitude course, computed theoretically, of the concentrations of these ions and of concentration ratios, agrees well with the available experimental data at various values of $z_\odot$. The use of Hinteregger data on the low intensity of sun's ultraviolet radiation, or of Ivanov–Kholodnyy data on the large flux in the ultraviolet region of the spectrum, does not affect substantially the derived conclusion, of the coincidence of ion concentration distributions, computed theoretically and measured experimentally, but leads only to the variation in the magnitude of the constants of processes. From the obtained data the most probable values of the constants of basic processes in the ionosphere can be estimated.
Author

N65-15161*# Consultants and Designers, Inc., Arlington, Va.
ON THE DENSITY OF THE UPPER ATMOSPHERE IN THE YEARS OF SOLAR ACTIVITY MINIMUM [O PLOTNOSTI VERKHNEY ATMOSFERY V GODY MINIMUMA SOLNECHNOY AKTIVNOSTI]
M. Ya. Marov 12 Jan. 1965 14 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, 1964 p 909–916
(Contract NAS5-3760)
(NASA-TT-F-9625; ST-AI-10274) OTS: HC $1.00/MF $0.50

This work presents atmospheric density determinations at heights approximately from 200 to 300 km, obtained by the deceleration of Soviet satellites of the Cosmos series, and of the capsule for the first Soviet spaceship–satellite (1960 ε_3). It is shown that at 200 km the density decreased by about a factor of 2, whereas at 300 km the decrease was of not less than three times, which apparently corresponds to the variation of solar decimeter radio emission for the period between years close to maximum and minimum levels of solar activity. Notable daily variations of density are ascertained in the indicated altitude range. Author

N65-15285# Ohio State U. Research Foundation, Columbus. Inst. of Geodesy, Photogrammetry, and Cartography
THE BOUNDARY VALUE PROBLEM OF PHYSICAL GEODESY Scientific Report No. 12
Helmut Moritz Aug. 1964 73 p refs
(Contract AF 19(628)-2771)
(IGPC-46; AFCRL-64-833; AD-609455)

This report compares the existing methods for solving the geodetic boundary value problem, i.e., the gravimetric determination of the geoid (traditional methods) or the physical surface of the earth (modern methods). A unified treatment is attempted by deducing all these methods from one very general integral equation. Gravity reduction is discussed from the traditional and the modern points of view. The different kinds of free-air anomalies and free-air reductions, which are a controversial subject, are compared. Emphasis lies on the general aspects of the methods discussed. Author

N65-15297# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
GEOLOGY OF THE YUKON FLATS REGION, ALASKA
Frank P. Heinsohn, Philip L. Johnson, and Ambrose O. Poulin Sep. 1964 35 p refs
(CRREL-TR-154; AD-451722)

The major landforms of Yukon Flats are flood plains with many meander scars and oxbow lakes, terraces, alluvial fans, and sand dunes. Permafrost is discontinuous but in the poorly drained areas, other than lakes, it occurs to a considerable depth. Glacial drift and moraines, formed during the Pleistocene glaciation of the southern Brooks Range, occur as extensive deposits in the Chandalar River drainage system. Pleistocene valley glaciation is evidenced in the higher mountains of the Hodzana Highland and the Ray Mountains by cirques, hanging valleys, U-shaped valleys, and moraine and outwash deposits. The geologic history of the area is summarized.
Author

N65-15298# California U., Berkeley. Space Sciences Lab.
MICROPULSATION INDUCTION EFFECTS, 15 to 40 SECONDS
Robert E. Warren Jul. 1964 54 p refs *Its* Ser., Issue 45
(Contract Nonr-222(69))
(AD-607914)

Observations of micropulsations in the vertical component of the geomagnetic field were made at 24 sites along a profile from Monterey Bay to Yosemite, California. The character of the observations shows a correlation with the sediment-filled valleys traversed, although the relative amplitudes often appear larger than expected for electric currents induced strictly in the valleys. Author

N65-15329# Geophysics Corp. of America, Bedford, Mass.
ATMOSPHERIC TRANSPORT OF ROCKET MOTOR COMBUSTION BY-PRODUCTS Tenth Monthly Letter Progress Report
12 Aug. 1964 21 p refs
(Contract N123(61756)34567A(PMR))

The tracing of rocket motor combustion byproducts from static firing tests was cancelled due to unfavorable weather conditions. Released transponder-equipped tetroons followed a trajectory closely approximating the streamlines estimated from existing low-level wind data. Equipment and fixtures for Arc A and Arc B of the aerosol sampling and meteorological instrument array were installed, and station locations for the installation of high-volume samplers and meteorological sensors along Arc D were selected. An index presents estimates of diffusion patterns for use in evaluating range-safety hazards involved in rocket destructs. Calculations are performed for source types of an instantaneous or quasi-instantaneous volume source that differ significantly from those of a point source. Summaries of the basic diffusion parameters for ground and elevated destructs at 300 and 600 m are presented in tables. G.G.

N65-15349# Canada. Dept. of Transport, Toronto. Meteorological Branch
ASTRONOMICAL SEEING CONDITIONS AND CLEAR AIR TURBULENCE
Anthony Wankiewicz 13 Jan. 1964 14 p refs
(CIR-3965; TEC-500)

A decade of extremes of astronomical seeing is studied in connection with atmospheric conditions. An attempt is made to relate seeing to turbulence parameters, especially those parameters favoring turbulence at tropopause levels. The gravity-wave vertical-shear mechanism is found to be significantly related to poor seeing conditions, suggesting that clear air turbulence is strongly involved in poor astronomical seeing. Author

N65-15382*# California U., La Jolla.
REDISTRIBUTION OF TRAPPED PROTONS DURING A MAGNETIC STORM
Carl E. McIlwain Apr. 1964 30 p refs
(Contract NASr-116; Grant NsG-538)
(NASA-CR-60314) OTS: HC $2.00/MF $0.50

The first observation of a change in the distribution of high-energy geomagnetically trapped protons which can be definitely attributed to the breakdown of adiabatic motion was obtained with the aid of a scintillation detector aboard the Relay I satellite. Most of the observed variation in proton fluxes took place within a period of one day centered on 0-hours u.t. September 23, 1963, during the occurrence of the largest fluctuations in the earth's magnetic field in almost two years. The intensity of protons with energies greater than 34 MeV decreased by over a factor of 10 in the region $L > 2.50$ earth radii and $B > .05$ G but changed by less than 10% in the region $1.80 > L > 2.10$. The character of the changes was such that previous events of this type could have produced the anomalous characteristics of the initial distribution. Author

N65-15391# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR APRIL 1964 FROM WOOMERA, SOUTH AUSTRALIA Ionospheric Data Bulletin
Oct. 1964 24 p
(CPD-1964/4(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for April 1964. Author

N65-15392# Denver U., Colo.
A COMPARATIVE STUDY OF TERRAIN ANALYSIS TECHNIQUES Technical Paper No. 64-2
Thomas M. Griffiths Feb. 1964 35 p refs
(Contract DA-31-124-AROD-79)
(AD-450591)

This paper presents a preliminary state-of-the-art study, an analysis of certain terrain quantification methods, criteria for the selection of a terrain test area, and the results of certain tests which were undertaken in the test area. A list of measurable terrain characteristics and a table of terrain-recording categories are given. The terrain test area is described, and the results of preliminary comparisons of a line-of-sight problem, slope measurement systems, and indices of terrain texture are presented. Author

N65-15424*# California U., La Jolla.
THE DRIFT VELOCITY OF TRAPPED PARTICLES
A. Hassitt 30 Sep. 1964 18 p refs
(Grant NsG-538)
(NASA-CR-60352) OTS: HC $1.00/MF $0.50

The longitudinal drift velocity of a particle trapped in the earth's field is considered. It is shown that there is a relation between drift velocities at different points on any line of force and that the drift velocities of particles with differing mirror points are also related. These relations can be used to simplify the calculation of the average effects of the atmosphere. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-14490# Systems Research Labs., Inc., Dayton, Ohio.
DEVELOPMENT OF TECHNIQUES FOR EVALUATION OF VISUAL SIMULATION EQUIPMENT Final Report, Mar. 1962–Apr. 1964
John H. Harshbarger and Arthur T. Gill (Aerospace Med. Res. Labs.) Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs., Aug. 1964 170 p refs
(Contract AF 33(657)-8299)
(AMRL-TDR-64-49; AD-607680) OTS: $5.00

A study of large area image display by projection television was undertaken to evolve techniques of suitable image generation for astronautical flight simulation training. It was necessary to develop a technique to evaluate projected images. The closed-circuit television system from an F-151 fixed gunnery trainer, was evaluated; and performance characteristics of the 7WP4 performance in an ultrahigh resolution television system revealed the tube to be unsuited to high resolution service. The projector in the F-151 television system is converted from a conventional 525-line format operated at 30 frames per second, with a horizontal scanning frequency of 15.75 kc and a vertical scanning frequency of 60 cps. In the 1029-line system, the frame rate and vertical scanning frequency were retained, but the horizontal scanning frequency was changed to 30.87 kc. The vertical sweep generator, sweep protection, and projection control circuits were duplicated; a video amplifier and horizontal sweep generator were developed; and volume of the control equipment was reduced from

144 to 32 cu ft. Performace of the 7WP4 tube exceeded the prediction; limiting horizontal resolution is 650 to 700 lines with a well defined vertical raster. Author

N65-14503 Naval Research Lab., Washington, D.C.
THE FABRY-PEROT REFRACTOMETER AND THE PRECISION NRL LYMAN-ALPHA HUMIDIOMETER
D. L. Randall, D. Stilwell, and O. K. Larison *In its* Rept. of NRL Progress Oct. 1964 p 4–12 refs (See N65-14501 05-20) OTS: $1.25

Two fast-response precision instruments for measuring microcells of moisture from an aircraft are now under development. One, the Fabry–Perot refractometer, uses an open-sided, spherical cap resonator which allows free flow of the air sampled in flight without loss of sensitivity. The loaded Q of this cavity is about 10000. The other is an improved Lyman-alpha humidiometer. The sensitivity of the improved humidiometer, over the range from 2 to 10 millibars, is 0.91×10^{-3} millibars of 3.8×10^{-3} moist refractive index units. When used with a photoelectric visicorder, a tape recorder, and a Packard-Bell 250 Computer, the humidiometer can make detailed plots of microcells at rates up to 100 cps. Author

N65-14504# Comstock and Wescott, Inc., Cambridge, Mass.
INVESTIGATION OF ULTRAVIOLET SOLAR RADIATION AND ITS INFLUENCE ON THE AEROSPACE ENVIRONMENT Final Report
J. D. Sullivan, J. F. Mc Grath, and W. J. Thorburn 31 Aug. 1964 262 p refs
(Contract AF 19(604)-7496)
(AFCRL-64-773; AD-608680)

CONTENTS:

1. RETARDING POTENTIAL ANALYZER 55 p ref (See N65-14505 05-14)
2. EUV TELEMETERING ROCKET MONOCHROMATOR 80 p (See N65-14506 05-14)
3. EXTREME ULTRAVIOLET SATELLITE TELEMETERING MONOCHROMATORS 39 p (See N65-14507 05-14)
4. XUV SPECTROPHOTOMETER FOR POGO SATELLITES 40 p refs (See N65-14508 05-14)
5. PROPORTIONAL COUNTER SPECTROMETER 33 p (See N65-14509 05-14)

N65-14505 Comstock and Wescott, Inc., Cambridge, Mass.
RETARDING POTENTIAL ANALYZER
In its Invest. of Ultraviolet Solar Radiation and its Influence on the Aerospace Environ. 31 Aug. 1964 55 p ref (See N65-14504 05-14)

The need for instrumentation for the analysis of photoelectron emission, environmental ions, and environmental electrons at the surface of a space vehicle has resulted in the development of the Retarding Potential Analyzer (RPA). The design, construction, and operation of the instrument are described, as well as the major modifications made to improve accuracy and reliability. Photographs, schematic diagrams, and assembly drawings are also presented. D.S.G.

N65-14506 Comstock and Wescott, Inc., Cambridge, Mass.
EUV TELEMETERING ROCKET MONOCHROMATOR
In its Invest. of Ultraviolet Solar Radiation and Its Influence on the Aerospace Environ. 31 Aug. 1964 80 p (See N65-14504 05-14)

The basic telemetering monochromator is a grazing-incidence grating monochromator using photoelectric detection techniques. It consists of an entrance slit, a concave grating (2-meter radius), a scanning drive, a continuous steel band with four equidistant slit cutouts, a tungsten cathode detector and secondary electron multiplier, and appropriate electronics for amplifying, counting, and telemetering the detected signal. For a rocket flight, the monochromator is mounted on a solar-pointing control in the nose cone. To date, 18 of these instruments have been flown on Aerobee 150 rockets. Improvements and modifications on the basic instrument are described, and photographs and assembly drawings are presented. D.S.G.

N65-14507 Comstock and Wescott, Inc., Cambridge, Mass.
EXTREME ULTRAVIOLET SATELLITE TELEMETERING MONOCHROMATORS
In its Invest. of Ultraviolet Solar Radiation and its Influence on the Aerospace Environ. 31 Aug. 1964 39 p (See N65-14504 05-14)

The instrument used as a backup experiment for one of two prime solar-pointed instruments on the Orbiting Solar Observatory, the OSO-B (S-17), was an adaptation of a more or less standard rocket monochromator, but it served as the basis for a more sophisticated instrument to be used on the OSO-C (S-57) spacecraft. Although the optical geometry of the latter was the same as used on the rocket monochromator, several other areas of design and additional specifications as to materials, electronic component access, construction, and machining techniques presented new problems. The problems and their solutions are discussed, and photographs and assembly drawings of the monochromator and its components are presented. D.S.G.

N65-14508 Comstock and Wescott, Inc., Cambridge, Mass.
XUV SPECTROPHOTOMETER FOR POGO SATELLITES
In its Invest. of Ultraviolet Solar Radiation and Its Influence on the Aerospace Environ. 31 Aug. 1964 40 p refs (See N65-14504 05-14)

The design and development of a spectrophotometer capable of measuring radiation in both the soft X-ray region and the extreme ultraviolet region (euv radiation) is reported. The spectrometer part of the experiment consists of three sections: the lower section, consisting of the collimator drive and position encoder mounted internally and the high voltage power supplies mounted externally; the middle section, containing the entrance aperture, gratings, collimator, and photomultiplier; and the upper section, containing the electronics circuitry. The operation, testing, and calibration of the instrument are described, and drawings and photographs are presented. D.S.G.

N65-14509 Comstock and Wescott, Inc., Cambridge, Mass.
PROPORTIONAL COUNTER SPECTROMETER
In its Invest. of Ultraviolet Solar Radiation and its Influence on the Aerospace Environ. 31 Aug. 1964 33 p (See N65-14504 05-14)

For measurement of the X-ray flux from the sun as an experiment simultaneous with the telemetering euv monochromator experiment on rocket flights, the proportional-counter technique was chosen because of its low noise level, short recovery time, and relatively good resolution in the soft X-ray range. The construction and operation of the instrumen

are described. The spectrometer was designed so that the detector and its associated circuitry could be mounted on a telemetering rocket monochromator that is flown on an Aerobee 150 rocket and pointed at the sun. The spectrometer analyzes solar radiation in five wavelength intervals between 0.8 Å and 10 Å.
D.S.G.

N65-14529# Eppley Lab., Inc., Newport, R.I.
THE TEST AND CALIBRATION OF A TIROS III FIVE-CHANNEL RADIOMETER
J. J. Roche, A. J. Drummond, and D. T. Hilleary 6 Apr. 1964 54 p refs
(Contract CWB-10075)
(AD-449574)

Calibration procedures for a TIROS III five-channel medium resolution scanning radiometer divides into the determination of: (1) the spectral response of each thermal channel (relatively); and (2) the integral wavelength sensitivity (absolutely) of these channels. Spectral response is obtained from comparison with nonselective wavelength detectors, with the radiometer and the detector being irradiated, in turn, monochromatically. Absolute total response is measured through exposure to known radiant energy fluxes in a wavelength band to which each channel is sensitive. Also discussed are: (1) the selection of optimum sources for calibrations; (2) the establishment of integral wavelength sensitivity in the infrared region through the use of blackbody radiators, and in the visible and near infrared regions by employment of an integrating hemisphere; and (3) the wavelength response and sensitivity of each channel. Insensitive readout instrumentation, electrical noise from exposure to atmospheric air, and wavelength selectivity or temperature dependence by some channels limited calibration accuracy.
M.G.J.

N65-14650# California U., San Diego. Visibility Lab.
RESTORATION OF ATMOSPHERICALLY DISTORTED IMAGES Progress Report
James L. Harris Mar. 1963 113 p ref
(Contract NObs-84075; ARPA Order 152-60)
(SIO-REF.-63-10; AD-404873)

Means of accomplishing restoration of atmospherically distorted images are being investigated. A photographic image of the block letters ARPA was subjected to simple forms of distortion, and it was shown experimentally that the true image can be recovered by methods analogous to those used to eliminate noise in telecommunication systems. The present report discusses, mathematical distortions and restorations, spatial frequencies, geometric distortion models, a mathematical model of astronomical distortions, and techniques and examples of time invariant distortions.
P.V.E.

N65-14681# Hoffman Electronics Corp., Santa Barbara, Calif. Science Center
INFRARED IMAGE CONVERTER Quarterly Report, 4 Feb.–30 Apr. 1964
C. C. Nash 30 Apr. 1964 7 p
(Contract NOw-64-0185-c)
(QR-1; AD-450827)

The design theory of a solid-state infrared image converter is presented as part of the feasibility study of such an image converter using a germanium photosensitive layer and a gallium arsenide radiating junction. Experimental work is described in which epitaxial heterojunctions were formed by the growth of gallium arsenide on germanium substrates. The problems of control of doping level and crystal structure are discussed.
D.S.G.

N65-14792# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
DESIGN, ADJUSTMENT, AND OPERATION OF AN OFF-AXIS SCHMIDT SPECTROGRAPH FOR PLASMA APPLICATIONS
E. J. Eastmond and E. B. Turner 10 Sep. 1964 38 p
(Contract AF 04(695)-269)
(SSD-TDR-64-170; TDR-269(4280-40)-1; AD-608279)

A large aperture spectrograph designed for plasma research applications is described. This instrument, which uses an off-axis Schmidt optical system, has a relative aperture of f/6 and a dispersion of 23 Å/mm in the first order. Either photographic film or photomultiplier tubes may be used to record the spectra. The design and characteristics of the optical system are discussed, and a detailed description is given of the alinement and adjustment procedure which is somewhat different from that of conventional spectrographs. The operation of the instrument, which includes the use of the photographic camera, the photomultiplier readout head, and the setting of the plane gratings for various spectral ranges is described in sufficient detail so that this report can be used also as a laboratory manual.
Author

N65-14839# System Development Corp., Santa Monica, Calif.
COMMAND RESEARCH LABORATORY: THE VARIABLE DISPLAY SYSTEM
Howard Burnaugh and William Moore 10 Aug. 1964 15 p
(SP-1722/001/00; AD-606179)

With the computer programs, light pen, and display console of the Variable Display System, tasks can be performed on line that are traditionally done off line with card-sorting and reproducing machinery. Tabular data may be retrieved from up to 58949 categories and manipulated on the display by selective application of the light pen to the surface of the cathode-ray tube. Data may be added, modified, deleted, and compressed; final or intermediate formulations may be printed out for later use.
P.V.E.

N65-14870# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
MICROPROBE STUDY OF ZIRCALOY CORROSION FILMS
Kurt F. J. Heinrich Nov. 1964 46 p refs
(Contract AT(07-2)-1)
(DP-906) OTS: $2.00

The primary object of this study was to determine the potential usefulness of the electron probe analyzer as a tool for the investigation and elucidation of problems in the corrosion of zirconium alloys, particularly Zircaloy-2. The general applicability of the probe to corrosion studies was demonstrated. Techniques were developed for the preparation and study of corroded zirconium alloy specimens. Previously unknown characteristics of the distribution of the component elements were revealed in Zircaloy-2 specimens and other zirconium alloys which had been subjected to various heat treatments. Data were also obtained on the composition and distribution of alloy elements in the fundamental corrosion layers. The possible significance of these findings is discussed in the light of current theories on corrosion mechanisms in zirconium alloys.
Author

N65-14871# Brookhaven National Lab., Upton, N.Y.
MULTIPLE NEUTRON SPECTROMETER CONTROL SYSTEM
R. J. Spinrad [1964] 10 p refs Presented at the EANDC Conf. on the Autom. Acquisition and Reduction of Nucl. Data, Kernforschungszentrum, Karlsruhe, W. Germany, 13–16 Jul. 1964
(BNL-8180)

A group of eight neutron spectrometers will soon be put in operation at the Brookhaven High Flux Beam Reactor. Although the different user groups will be engaged in independent research programs, all the spectrometers will be under the control of a single stored-program digital computer. On a time-shared basis, the computer will control the motion of all of the axes of rotation and operate all the neutron detectors and monitors. In addition the computer will handle all the angle-specifying computations and will perform a certain amount of data reduction in real time. Control of the individual spectrometers exists at three levels: (1) by a control panel at each spectrometer, (2) through typewritten commands at the computer console, and (3) through individual stored programs in the computer memory. Author

N65-14894# Joint Publications Research Service, Washington, D.C.

IZVESTIYA VUZov: INSTRUMENT BUILDING, VOLUME VII, NO. 5, 1964

11 Jan. 1965 237 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), v. VII, no. 5, 1964 p 3–178

(JPRS-28229; TT-65-30107) OTS: $6.00

CONTENTS:

ELECTRONIC INSTRUMENTS

1. SELECTION OF THE RELATIVE PLACEMENT OF TWO CIRCULAR WIRE LOOPS FOR MINIMUM MUTUAL INDUCTANCE G. A. Ostroumov p 1–4 refs (See N65-14895 05-14)

ELECTRICAL MEASURING INSTRUMENTS

2. SIMULATION OF AUTOMATIC ALTERNATING-CURRENT BRIDGES WITHIN QUADRATURE DETECTION M. A. Gavrilyuk p 5–13 refs (See N65-14896 05-14)

3. ON SELECTION OF FEED FREQUENCY OF AN AUTOMATIC QUASI-BALANCED BRIDGE WITH DIFFERENTIAL INDICATOR Yu. A. Skripnik and A. D. Nizhenskiy p 14–24 refs (See N65-14897 05-14)

4. DIRECT-CURRENT AMPLIFIER FOR ELECTRONIC DIGITAL VOLTMETERS B. I. Shvetskiy p 25–33 refs (See N65-14898 05-14)

5. CONVERTER FOR MEASURING THE INSULATION RESISTANCE OF ALTERNATING CURRENT SUPPLY SYSTEM Ye. A. Starosel'tseva p 34–42 refs (See N65-14899 05-14)

6. ACCURACY OF SIMULATION OF ELECTRIC SIGNALS BY MEANS OF MAGNETIC RECORDING A. I. Naydenov p 43–51 refs (See N65-14900 05-14)

AUTOMATION AND COMPUTER INSTRUMENTS

7. CIRCUITS OF DIFFERENTIATION OF ENVELOPE OF AMPLITUDE MODULATED SIGNALS V. I. Anisimov and Yu. F. Likhodiyevskiy p 52–59 refs (See N65-14901 05-14)

8. EFFECT OF VARIATIONS OF TIME PARAMETERS ON THE ACCURACY OF OPERATION OF PULSE-AMPLITUDE TELEMETERING SYSTEMS Ye. I. Semenov p 60–65 refs (See N65-14902 05-14)

9. EVALUATION OF ACCURACY OF THE HARMONIC BALANCE METHOD ON ITS USE FOR DETERMINING SIMPLE NATURAL OSCILLATIONS IN RELAY SYSTEMS M. P. Granstrem p 66–78 refs (See N65-14903 05-14)

10. INCREASING THE DATA TRANSMISSION EFFICIENCY OF CODE TELEMETERING SYSTEMS V. I. Vasil'yev p 79–89 refs (See N65-14904 05-07)

11. NEW METHOD OF CONSTRUCTION OF SERIES DECODERS Yu. I. Volkov and F. E. Keller p 90–97 refs (See N65-14905 05-07)

12. COMPENSATION OF DYNAMIC ERRORS IN A COMBINED SYSTEM OF PROGRAMMED CONTROL A. A. Bezvikonnyy p 98–108 refs (See N65-14906 05-10)

13. SELECTION OF PARAMETERS OF A TWO-CHANNEL SERVOSYSTEM WITH A DIGITAL COMPUTER A. N. Gerasimov and S. V. Luchko p 109–118 refs (See N65-14907 05-07)

14. THE MOST ADVANTAGEOUS BASE IN RECKONING SYSTEMS WITH REDUNDANT DIGITS REPRESENTATION N. N. Posnov p 119–122 refs (See N65-14908 05-19)

15. SINGLE-DIGIT DECIMAL ADDER EMPLOYING FERRITE-TRANSISTOR CELLS A. M. Kayumov p 123–127 refs (See N65-14909 05-08)

GYROSCOPIC AND NAVIGATIONAL INSTRUMENTS

16. DYNAMICS OF A THREE-AXIS GYROSTABILIZER V. N. Karpov p 128–136 refs (See N65-14910 05-14)

17. EQUATIONS OF MOTION FOR THE SPERRY MK-19 GYROSCOPE V. V. Seregin p 137–143 refs (See N65-14911 05-14)

PRECISION INSTRUMENTS

18. CONCERNING THE PROBLEM OF CONSTRUCTION OF HIGH-PRECISION ELECTROMAGNETIC FLOWMETERS I. L. Shayn and Ye. G. Abarinov p 144–154 refs (See N65-14912 05-14)

19. STATIC EQUIPOISING OF THE BALANCE OF A CLOCKWORK MECHANISM K. V. Sorokina p 155–163 refs (See N65-14913 05-14)

OPTICAL INSTRUMENTS

20. PROCEDURE AND RESULTS OF AN INVESTIGATION OF THE SPECTRAL REFLECTION FROM SCATTERING MATERIALS IN THE LONGWAVE INFRARED PORTION OF THE SPECTRUM M. A. Kropotkin and B. P. Kozyrev p 164–170 refs (See N65-14914 05-14)

21. CALCULATION OF THE ACCURACY OF AN AUTOMATIC PHOTOELECTRIC ANGLE-MEASURING SYSTEM Yu. G. Yashenkov p 171–174 refs (See N65-14915 05-14)

22. INTRODUCTION OF ISOPLANATIC LENSES FOR INCREASING THE RELATIVE APERTURE IN WIDE-ANGLE LENSES P. D. Ivanov p 175–178 ref (See N65-14916 05-14)

THERMAL INSTRUMENTS

23. CONDITIONS FOR TEMPERATURE REGULARIZATION OF MONOTONICALLY HEATED BODIES HAVING SIMPLEST SHAPES AND VARIABLE THERMOPHYSICAL PARAMETERS Ye. S. Platunov p 179–185 refs (See N65-14917 05-33)

24. CONVECTIVE HEAT TRANSFER COEFFICIENT AT LOW PRESSURE A. M. Kirik and I. I. Tuktayev p 186–189 refs (See N65-14918 05-33)

25. THERMAL REGIMES FOR SEMICONDUCTOR DIODES IN A-C CIRCUITS A. A. Abdulayev p 190–196 refs (See N65-14919 05-09)

26. INVESTIGATION OF THE THERMAL REGIMES OF SEMICONDUCTOR DEVICES BY THE EQUIVALENT CIRCUIT METHOD P. D. Davydov p 197–205 refs (See N65-14920 05-09)

27. DETERMINATION OF WATER VAPOR CONTENT IN GASES WITH A CONDENSER V. A. Potroshkov p 206–210 refs (See N65-14921 05-33)

INSTRUMENT MECHANISMS AND COMPONENTS

28. CALCULATION OF MANOMETER SPRINGS M. P. Shumskiy p 211–220 refs (See N65-14922 05-14)

29. CALCULATION OF SOME ELASTIC ELEMENTS OF INSTRUMENTS V. N. Zheludkov p 221–232 refs (See N65-14923 05-23)

N65-14895 Joint Publications Research Service, Washington, D.C.

SELECTION OF THE RELATIVE PLACEMENT OF TWO CIRCULAR WIRE LOOPS FOR MINIMUM MUTUAL INDUCTANCE

G. A. Ostroumov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 1–4 refs (See N65-14894 05-14) OTS: $6.00

The problem of magnetic decoupling in inductance coils is solved by finding the simultaneous zeros of four partial differential equations in terms of the cylindrical and polar coordinates of the movable loop. According to symmetry concepts the mutual orientation of the loops in free space is so selected that infinitely small variations in the coordinates produce mutual induction of the second order of smallness. The four-degree-of freedom matrix is derived, and examples are solved, relying solely on symmetry. E.P.V.

N65-14896 Joint Publications Research Service, Washington, D.C.

SIMULATION OF AUTOMATIC ALTERNATING-CURRENT BRIDGES WITHIN QUADRATURE DETECTION

M. A. Gavrilyuk *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 5–13 refs (See N65-14894 05-14) OTS: $6.00

Problems of mathematical simulation, with electronic models, of a group of automatic ac bridges are considered. Equations of dynamics of the bridges under consideration, functional diagrams of equation assembly for the models, and simulation results are presented. Concise recommendations are given on selection of the balancing region. Author

N65-14897 Joint Publications Research Service, Washington, D.C.

ON SELECTION OF FEED FREQUENCY OF AN AUTOMATIC QUASI-BALANCED BRIDGE WITH DIFFERENTIAL INDICATOR

Yu. A. Skripnik and A. D. Nizhenskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 14–24 refs (See N65-14894 05-14) OTS: $6.00

A single-channel, phase-insensitive differential indicator with an electronic commutator, for an automatic quasi-balanced bridge is considered. High negative feedback in both channels of commutator reduces error due to unidentical vacuum tubes to a permissible magnitude. Relations are given to permit evaluation of effect the phase shift of input voltages on accuracy of comparison of their amplitude values. Recommendations are made on selection of feed frequency of automatic quasi-balanced bridge with differential indicator, the output voltage of which is directly utilized to control an asynchronous reversible motor. Author

N65-14898 Joint Publications Research Service, Washington, D.C.

DIRECT-CURRENT AMPLIFIER FOR ELECTRONIC DIGITAL VOLTMETERS

B. I. Shvetskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 25–33 refs (See N65-14894 05-14) OTS: $6.00

An analysis is presented of the input direct current amplifier (DCA) of an electronic digital voltmeter which ensures an amplification factor K = 10 with instability and nonlinearity of less than 0.02% per hour. The DCA is characterized by high input resistance; output voltage is symmetrical relative to ground. Author

N65-14899 Joint Publications Research Service, Washington, D.C.

CONVERTER FOR MEASURING THE INSULATION RESISTANCE OF ALTERNATING CURRENT SUPPLY SYSTEM

Ye. A. Starosel'tseva *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 34–42 refs (See N65-14894 05-14) OTS: $6.00

This article presents the principle of operation, and a description of the electric setup of a converter of insulation resistance of an alternating current supply system. Some premises of calculation of the circuitry and an evaluation of converter errors are given, as well as considerations relative to dependability of converter performance based on calculation and experimental data. Author

N65-14900 Joint Publications Research Service, Washington, D.C.

ACCURACY OF SIMULATION OF ELECTRIC SIGNALS BY MEANS OF MAGNETIC RECORDING

A. I. Naydenov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 43–51 refs (See N65-14894 05-14) OTS: $6.00

This article presents an analysis of the accuracy of simulation of electric signals of complex form, predetermined as graphs, by means of magnetic recording. Analog model study of signal recordings of variable intensity and variable width is considered. A digital model study is presented. Author

N65-14901 Joint Publications Research Service, Washington, D.C.

CIRCUITS OF DIFFERENTIATION OF ENVELOPE OF AMPLITUDE MODULATED SIGNALS

V. I. Anisimov and Yu. F. Likhodiyevskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 52–59 refs (See N65-14894 05-14) OTS: $6.00

Two circuits are considered for the differentiation of envelope of amplitude modulated signals, in which the functions of modulator and demodulator are performed by a single commutation unit. Author

N65-14902 Joint Publications Research Service, Washington, D.C.

EFFECT OF VARIATIONS OF TIME PARAMETERS ON THE ACCURACY OF OPERATION OF PULSE-AMPLITUDE TELEMETERING SYSTEMS

Ye. I. Semenov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 60–65 refs (See N65-14894 05-14) OTS: $6.00

Questions are considered related to the influence of variations of time parameters on accuracy of operation of pulse-amplitude telemetering systems. Recommendations are made on selection of basic parameters of the receiver of such systems with a memory capacitor and low frequency filter. Author

N65-14903 Joint Publications Research Service, Washington, D.C.
EVALUATION OF ACCURACY OF THE HARMONIC BALANCE METHOD ON ITS USE FOR DETERMINING SIMPLE NATURAL OSCILLATIONS IN RELAY SYSTEMS
M. P. Granstrem *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 66–78 refs (See N65-14894 05-14) OTS: $6.00

On the basis of the work of P. Zagirov an evaluation is made of the accuracy of the harmonic balance method in the case of natural oscillations in relay systems with one relay element. Author

N65-14910 Joint Publications Research Service, Washington, D.C.
DYNAMICS OF A THREE-AXIS GYROSTABILIZER
V. N. Karpov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 128–136 refs (See N65-14894 05-14) OTS: $6.00

The effect of cross coupling between the control channels of a triaxial gyrostabilizer on the accuracy of stabilization and drift of the gyroplatform was analyzed. Linear cross couplings between channels of a three-axis gyroscope increased the error in each channel, and it was found that under the action of harmonic perturbation, even in only one axis, the platform would drift with respect to inertial space. When self-oscillation modes existed in the channels, they could synchronize through the cross couplings and increase the drift of the platform. It was also found that platform drift due to system dynamics could be decreased by appropriate selection of control parameters and, in particular, of parameters controlling the self-oscillation modes. P.V.E.

N65-14911 Joint Publications Research Service, Washington, D.C.
EQUATIONS OF MOTION FOR THE SPERRY MK-19 GYROSCOPE
V. V. Seregin *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 137–143 refs (See N65-14894 05-14) OTS: $6.00

Differential equations describing the precessional motions of a Sperry MK-19 gyrocompass in a ship moving arbitrarily over the surface of the earth are derived. The moments arising from instrumental errors (imbalance, nonperpendicularity of the axis, etc.) are neglected, and the characteristics of the controlling moments are assumed to be linear and without dead zones. P.V.E.

N65-14912 Joint Publications Research Service, Washington, D.C.
CONCERNING THE PROBLEM OF CONSTRUCTION OF HIGH-PRECISION ELECTROMAGNETIC FLOWMETERS
I. L. Shayn and Ye. G. Abarinov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 144–154 refs (See N65-14894 05-14) OTS: $6.00

Accuracy of an electromagnetic flowmeter can be substantially enhanced on using as the pickup of the sensor, an automatic rectangular-coordinate compensator of alternating current. An analysis is presented of the circuit of an electromagnetic flowmeter, an expression is derived for the error of its indication, and ways are shown to increase the accuracy of the latter. Author

N65-14913 Joint Publications Research Service, Washington, D.C.
STATIC EQUIPOISING OF THE BALANCE OF A CLOCKWORK MECHANISM
K. V. Sorokina *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 155–163 refs (See N65-14894 05-14) OTS: $6.00

An instrument is offered for static equipoising of the balance assembly to determine the magnitude of out-of-poise of a balance. It is possible to correct the latter considerably faster than on equipoising with the presently available instruments, while enhancing at the same time the quality of correction. For determination of the out-of-poise moment of a balance the latter is placed in the rotating magnetic field of the stator of an electric motor. Determination of the moment of out-of-poise of the balance consists of a uniform increase of intensity of the magnetic field and the determination of the moment-of-force exerted by the field with respect to the axis of the balance at the instant of incipient rotation of the latter. Author

N65-14914 Joint Publications Research Service, Washington, D.C.
PROCEDURE AND RESULTS OF AN INVESTIGATION OF THE SPECTRAL REFLECTION FROM SCATTERING MATERIALS IN THE LONGWAVE INFRARED PORTION OF THE SPECTRUM
M. A. Kropotkin and B. P. Kozyrev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 164–170 refs (See N65-14894 05-14) OTS: $6.00

The optical equipment, electrical circuits, structure, and calibration of the vacuum system for studying the reflection spectra of scattering materials in the long wave portion of the infrared spectrum are described. A description of the procedure used to operate the equipment and the infrared reflected spectra taken with the apparatus are presented; the accuracy of the results is evaluated. Author

N65-14915 Joint Publications Research Service, Washington, D.C.
CALCULATION OF THE ACCURACY OF AN AUTOMATIC PHOTOELECTRIC ANGLE-MEASURING SYSTEM
Yu. G. Yashenkov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 171–174 refs (See N65-14894 05-14) OTS: $6.00

A photoelectric servosystem with a light-divider unit used as an image analyzer is discussed briefly. Relations are given allowing calculation of the accuracy with which direction is determined by such a system if the parameters of the individual components are known. Author

N65-14916 Joint Publications Research Service, Washington, D.C.
INTRODUCTION OF ISOPLANATIC LENSES FOR INCREASING THE RELATIVE APERTURE IN WIDE-ANGLE LENSES
P. D. Ivanov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 175–178 ref (See N65-14894 05-14) OTS: $6.00

A recommendation is made to use two isoplanatic lenses between which there is a lens with a large field of view and relative aperture for the purpose of obtaining a high light-gathering power. With the aid of such a lens it is possible to correct all residual aberrations from the front component. Author

N65-14922 Joint Publications Research Service, Washington, D.C.
CALCULATION OF MANOMETER SPRINGS
M. P. Shumskiy *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 211–220 refs (See N65-14894 05-14)
OTS: $6.00

An approximate general solution is presented of the problem concerning stresses and displacements in manometer springs. The results are derived in a simple analytical form, which permits a comparative analysis of springs with cross sections of different shape to determine optimal variants. Author

N65-14997# ARO, Inc., Arnold Air Force Station, Tenn.
A LOW-LOAD THREE-COMPONENT FORCE BALANCE FOR MEASUREMENTS IN A LOW-DENSITY WIND TUNNEL
George D. Arney, Jr. and Wade T. Harter Arnold Eng. Develop. Center, Dec. 1964 25 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-280; AD-453130)

This paper describes a three-component force balance which has been developed for measurement of lift, drag, and pitching moment acting on models in a low-density, hypervelocity wind tunnel. Although designed for a particular wind tunnel, the general arrangement and the principles involved should be applicable to similar situations. The balance is of the external type operating on the nulling principle. Nulling of each component is accomplished automatically through the use of closed-loop control systems. Calibration data and sample wind-tunnel measurements are presented which demonstrate that the balance is suitable for the intended application. Author

N65-15026# California U., Berkeley. Lawrence Radiation Lab.
THE DESIGN, CONSTRUCTION, AND OPERATION OF A DIFFERENTIAL MICROMANOMETER. PART I: ELECTRONICS
Kenneth W. Lamers 16 Oct. 1964 33 p refs
(Contract W-7405-ENG-48)
(UCRL-11218, Pt. I) OTS: $2.00

This report covers the electronics of a micromanometer designed to measure pressure differentials on the order of 0.1 micron with an accuracy of 3%. The micromanometer is used in conjunction with a Wrede gage, a device that converts atomic concentration into a pressure differential. The pressure difference is sensed by a membrane manometer constructed in the form of a differential capacitor that forms two legs of a resonant-bridge network excited by a radio-frequency source. The bridge output (2.7 mc) is amplified and fed to a phase-sensitive detector that determines the direction of unbalance and develops a dc voltage that restores the membrane essentially to its initial position. The restoring voltage is directly proportional to pressure differential and is indicated by a recorder. Author

N65-15042# Dupont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
A PERISCOPE FOR VIEWING AND PHOTOGRAPHING RADIOACTIVE OBJECTS UNDERWATER
F. C. Locke Nov. 1964 12 p ref
(Contract AT(07-2)-1)
(DP-931) OTS: $1.00

A periscope was developed and is currently being used for the visual examination of irradiated reactor fuel in a water-filled basin. Of the several advantages which this instrument has over those periscopes commercially available, the most notable are its low cost and its ease of maintenance because of the above-water placement of all precision optical components. Its optical quality has proven satisfactory for both visual and photographic work. The periscope consists of a vertical view tube welded perpendicularly to a short horizontal tube, on the front of which is a sealed glass window. A first-surface mirror, placed at the intersection of the two tubes, reflects light from the window to a telescope and camera mounted at the upper end of the vertical tube. The periscope can be raised, lowered, and rotated manually to provide a large viewing area. Four 500-W lamps are attached to the lower end of the vertical tube for spot illumination of the viewing area. Author

N65-15068# Suffield Experimental Station, Ralston, Alberta (Canada).
SELF-ALIGNING SCHLIEREN STOPS
J. C. Muirhead and A. T. Froebel 4 Nov. 1964 12 p refs
(Suffield-TN-71)

A self-alining schlieren system was developed to prevent the wandering of the focus from the boundary between an opaque and a transparent region. Three types of repetitive opaque–transparent schlieren stops were designed and tested: (1) to replace a knife edge; (2) to replace a pinhole stop; and (3) to overcome "blind-spots" that occur when light is refracted diagonally, e.g., from opaque square to opaque square. All stops performed well and were insensitive to all but longitudinal misalinements, but they did not always give pictures as good as those given by the conventional schlieren methods. G.G.

N65-15111# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HANDBOOK OF MEDICAL INSTRUMENTS
A. G. Kreytser 13 Aug. 1964 251 p refs Transl. into ENGLISH of the book "Spravochnik po Meditsinskim Priboram" Leningrad, Gos. Izd. Med. Lit., 1962 p 3–196
(FTD-TT-63-1059/1+2; AD-607904)

This manual contains data and descriptions of diagnostic and measuring devices used in clinical laboratory tests, with the exception of ophthalmological, otorhinolaryngological, and X-ray equipment. The handbook describes cardiovascular, respiratory, bioelectric, and biochemical test equipment. Included is a bibliography of recent medical methods and techniques. G.G.

N65-15140*# CBS Labs., Stamford, Conn. Electron Tube Dept.
1-1/2 INCH RUGGED IMAGE DISSECTOR TUBE Final Report, 25 Feb.–18 Sep. 1964
S. Juchnowycz 12 Oct. 1964 39 p Prepared for JPL
(Contract JPL-950848)
(NASA-CR-60195) OTS: HC $2.00/MF $0.50

An extremely rugged image dissector tube was developed to withstand mechanical shock and vibrations in excess of the Mariner C flight qualification test. Increased dynode and cathode uniformity was achieved through improved processing techniques, and changes in processing of the tube on the pump reduced dark current by more than 50% from the original image dissector tube. The addition of "snubbers" to the electron multiplier assembly kept its movements to a minimum during exposure to several environmental conditions. G.G.

N65-15144*# Giannini Controls Corp., Duarte, Calif. Control/Nucleonics Div.
VENT QUALITY METER STUDY Final Report
J. G. Kyser 7 Dec. 1964 196 p Revised
(Contract NAS8-11814)
(NASA-CR-60175; ER-80194) OTS: HC $5.00/MF $1.25

Presented are the results of a study of 10 techniques which seem to have applicability to the problem of determining the relative amounts of liquid and vapor present in a two-phase flow through pipes of from 1- to 10-inch diameter. It was concluded that density measurement by gamma-ray absorption covers the full range of requirements, and that the source strengths will be reasonable and the shielding weight will be low. The gamma-ray absorption method has the following advantages: (1) All components are external to the pipe. (2) All requirements can be met with identical hardware. (3) The system is simple, reliable, and easy to calibrate. (4) The system has reasonable weight and power requirements. R.R.D.

N65-15149*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ZERO-RATE ERROR IN A VIBRATORY DOUBLE-MODULATION GYROSCOPE
Joseph A. D'Appolito Sep. 1964 35 p refs
(Grant NsG-149-61)
(NASA-CR-60190; ESL-R-207) OTS: HC $2.00/MF $0.50

A mathematical analysis is made of a square wave switching demodulator in which distinct random noises are simultaneously present on both the input and reference signals, these noises being correlated. General expressions for the demodulator output autocorrelation function and power density spectrum are obtained under the assumption that the noises are jointly gaussian and subject only to the restriction that the reference signal-to-noise ratio be large. Suspected noise sources and the mechanisms through which they are coupled into the signal processing electronics are then postulated, and using the above analysis, the resultant zero-rate output they would produce is predicted. This study indicates that noise induced in the sensing element by mechanical vibration produced during double modulation constitutes a second major source of zero-rate error. The study also shows that demodulator reference signal noise does not produce significant zero-rate output. Author

N65-15184*# Honeywell, Boston, Mass. Radiation Center
MAGNETOMETER SENSOR DEVELOPMENT PROGRAM Final Report
Burton A. Pearlstein, Donald T. Longland, and David E. Ratcliff Dec. 1964 18 p
(Contract NAS2-2070)
(NASA-CR-60211) OTS: HC $1.00/MF $0.50

For improved performance of fluxgate magnetometer sensors, specifications for annealed and unannealed Permalloy have been determined, with size optimized at 1/16 in. × 1/8 mil thick. The material has acceptable low-noise characteristics for producing sensors with 0 to 10 cps bandwidth peak-to-peak noise characteristics of from 0.15 to 0.35 gammas. Annealing after manufacturing is not necessary as winding the magnetic material on the sensor bobbin after final annealing does not degrade its noise characteristics. Second harmonic feedthrough has been substantially reduced by use of a feedthrough cancellation voltage winding system. A fluxgate magnetometer sensor, incorporating these improvements, has been fabricated, tested, and shipped. M.G.J.

N65-15225*# Michigan U., Ann Arbor.
[RESEARCH RELEVANT TO METEOROLOGICAL SATELLITES IN ADVANCED MEASURING TECHNIQUES OF HIGH ALTITUDE] Sixth Quarterly Status Report, 1 May–31 Jul. 1964
Fred L. Bartman and L. M. Jones 4 Dec. 1964 4 p
(Contract NASr-54(03))
(NASA-CR-60202) OTS: HC $1.00/MF $0.50

Work is reported on the laboratory testing of radiation-measuring instruments, the analysis of data obtained on previous balloon flights, the design and construction of equipment for succeeding balloon flights, an analytical study of atmospheric radiation processes, and the development of an infrared interferometer for spacecraft use. The major portion of the work and of this report was concerned with the infrared interferometer. D.E.W.

N65-15256# California U., Berkeley. Lawrence Radiation Lab.
INSTRUMENTATION MODULE SYSTEM
Dick A. Mack, Leo Schifferle, and Clayton A. Van Den Heuvel 25 Nov. 1964 70 p
(Contract W-7405-ENG-48)
(UCRL-11702) OTS: $3.00

A versatile system of constructing modular plug-in units is described together with its associated bin and interconnecting wiring. These units conform to the standard recently developed and adopted by the AEC Committee on Nuclear Instrument Modules. Author

N65-15311# ARO, Inc., Arnold Air Force Station, Tenn.
A HIGH VACUUM CALIBRATION SYSTEM
F. G. Sherrell and A. J. Mathews Arnold Eng. Develop. Center, Jan. 1965 35 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-275; AD-454480)

A vacuum calibration system for establishing partial pressures of common residual gases is described. System accuracy is maintained at ±5% throughout the range of 10^{-8} to 10^{-4} torr. A porous leak is used to introduce gases into a test region which is exhausted through an orifice in a thin diaphragm. Calibration efforts are minimized by providing a very large system pumping speed below the orifice. Typical mass spectrometer and ionization gage calibration data are presented. Author

N65-15319# Michigan U., Ann Arbor. Infrared Physics Lab.
MINUTES OF THE IMAGE ORTHICON SEMINAR, 4 AND 5 JUNE 1963
Robert L. Boggess and Ira W. Pence, Jr., ed. Oct. 1964 66 p
(Contract ARPA-SD-210)
(Rept. 5933-5-X; AD-450790)

This document contains a brief synopsis and edited transcript of a seminar on image orthicons. This meeting was held to ascertain the present state-of-the-art of image tubes, orthicons, and vidicons, with emphasis on their use in space observations and astronomical research. Author

N65-15326# Kollsman Instrument Corp., Elmhurst, N.Y.
BIO-INSTRUMENTATION FOR CONTROL OF PRESSURE CHAMBERS
M. Chodes Port Washington, N.Y., Naval Training Device Center, 10 Aug. 1964 126 p refs
(Contract N61339-1182)
(NAVTRADEVCEN-1182-5; AD-607741)

The bio-instrumentation for control of pressure chambers, is designed to monitor the environment within altitude-simulation chambers and alert the chamber operator to the existence of conditions that are hazardous to the chamber occupants. Specifically, the instrumentation continuously monitors and displays the following: percent oxygen, percent carbon dioxide, percent carbon monoxide, temperature, humidity, pressure–altitude, and duration of exposure. This report provides a complete description of the bio-instrumentation, in terms of the system as a whole and of the individual components and subsystems. The results of physiological investigations are included, together with background information and an extensive bibliography. The report contains detailed procedures for installing, calibrating, and operating the instrumentation, and for performing preventive maintenance.

Author

N65-15336*# Arizona U., Tucson. Engineering Research Labs.
DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES Third Six-Month report, Jul. 1–Dec. 30, 1964
Stuart A. Hoenig, Melvin M. Eisenstadt, and Charles W. Carlson [1964] 27 p refs
(Grant NsG-458)
(NASA-CR-60278) OTS: HC $2.00/MF $0.50

A series of chemisorption detectors for specific gases was developed. Detectors for O_2 and H_2 under vacuum conditions were finished, and detectors for water vapor, hydrogen, and atomic hydrogen are under development. A large (18-in. × 22-in.) ultrahigh-vacuum chamber was completed.

Author

N65-15350*# Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Third Quarterly Report, Sep. 1–Nov. 30, 1964
Anthony J. Cassano 28 Dec. 1964 72 p refs
(Contract NAS3-4170)
(NASA-CR-54276; CCC-462) OTS: HC $3.00/MF $0.75

Continuing development of a pressure transducer system for liquid metal applications is described. During the report period, emphasis was on the experimental program and the following results are presented: (1) pressure–deflection–temperature characteristics of pressure capsules of FS-85 and W-25Re alloys; (2) current-spacing characteristics of the latest thermionic diode sensor; (3) Q-meter data on the variable impedance sensor; and (4) life-test data on a representative electrical terminal. Design configurations are presented for potassium compatibility testing of the pressure capsules and the electrical terminal.

Author

N65-15359# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (W. Germany).
MEASUREMENT OF TERRESTRIAL THERMAL MICROWAVE RADIATION BY AIRBORNE EQUIPMENT [MESSUNG DER THERMISCHEN MIKROWELLENSTRAHLUNG DES ERDBODENS VOM FLUGZEUG AUS]
K. März Oct. 1964 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-30) Available from ZLDI, Munich: DM 11.10

This paper describes an airborne experimental setup for measuring terrestrial thermal microwave radiation in the frequency range around 35 GHz (8-mm wavelength). The obtained characteristic equipment data (receiver noise temperature, constancy of calibration) and the results of the experimental flights are stated. These results show that, to a certain extent, microwave radiometers can be used as a navigational aid for aviation.

Author

N65-15367*# Texas U., Dallas. Southwestern Medical School
[TECHNICAL EVALUATION OF A ONE-INCH MINIATURIZED VIDICON IN COMBINATION WITH A MINIATURIZED PHASE MICROSCOPE] Semiannual Status Report, Oct. 1, 1962–Mar. 31, 1963
P. O'B. Montgomery [1963] 5 p
(Grant NsG-210-62)
(NASA-CR-50262) OTS: HC $1.00/MF $0.50

Progress is reported in the following areas: (1) A 1-inch miniaturized vidicon camera in combination with a miniaturized phase microscope was evaluated as a scanning system for biological experiments in satellites; focus and contrast inadequacies were evident and a modified vidicon is being prepared. (2) A newly developed ultraviolet emitting phosphor is being purified for preparation of a high-quality scanner tube. (3) The stepping spot microscope was improved and is being adapted to film scanning, rather than direct specimen scanning. (4) A complete prototype of equipment for cell studies in satellite experiments was fabricated. (5) Studies of the effects of high gravity on *E. coli* proved that these bacteria show a decrease in all aspects of growth at 100 000 G, and that they continue to grow but do not divide, thus producing giant forms of the bacteria. (6) Studies of the effects of 20 and 40 G gravitational fields on the locomotion, the reproduction, and the heredity of amoeba and planaria are being conducted by using a centrifuge microscope. (7) Ultrastructural changes in cells subjected to 500-R ionizing radiation were established.

M.P.G.

N65-15405# Douglas Aircraft Co., Inc., Santa Monica, Calif.
AN ELECTROMECHANICAL CONING DAMPER, REBOUND PROJECT, MODEL DSV-5
A. D. Shvetzoff Jan. 1962 15 p
(Contract NAS5-1294)
(NASA-CR-60341; SM-41393) OTS: HC $1.00/MF $0.50

Development of the equations has shown that a spinning rigid body which is coning may be controlled by a wheel internal to it, rotating in a prescribed manner relative to the inertial motion of the body. The proper relationship between the rotation of the wheel and the body may be sensed by an accelerometer mounted in the plane of the cg. The accelerometer should be mounted parallel to the centerline at a location 90° away from the centerline of the wheel. The effect of the coning damper is to constrain the rate of change of the coning angle to be always negative.

Author

N65-15407*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN X-RAY SPECTROGRAPH FOR LUNAR SURFACE ANALYSIS
Albert E. Metzger 16 Oct. 1964 34 p refs
(Contract NAS7-100)
(NASA-CR-60340; JPL-TR-32-669) OTS: $2.00/MF $0.50

The performance of a proposed X-ray spectrograph for the in situ analysis of powdered samples of lunar material is described. The instrument employs electron beam excitation, with dispersive crystal resolution in a fixed-channel geometry. A nondispersive capability by means of pulse height analysis is also included. Stable X-ray emission has been achieved by lowering the electrical resistivity of the sample. Thermal measurements show that heating of the sample by the electron beam is not excessive. Variations in particle size and shape

have been found to affect the response, but these become serious only in extreme cases. The processes of interelemental X-ray absorption and enhancement are discussed and are illustrated by curves of response as a function of composition. Experimental results using both synthetic and natural rock materials are presented for the dispersive and nondispersive modes. Author

N65-15419# Canadian Armament Research and Development Establishment, Valcartier.
DESCRIPTION OF THE INSTRUMENTATION OF CARDE BLACK BRANT ROCKETS CC II-29 AND 30
O. Bourque Dec. 1964 24 p
(CARDE-TN-1637/64)

The instrumentation mounted in the Propulsion Test Vehicles CC II-29 and CC II-30 in the series of dynamic tests of the BLACK BRANT II rocket engines is described. The instrumentation was of two types: the sensing devices or transducers, and the encoding and transmitting systems. Measurements were made and successfully telemetered of rocket engine pressure, trajectory and dispersion, acceleration along three axes, nose cone temperatures, vehicle attitude, angle-of-attack in pitch and yaw, temperatures of chosen spots in the electronic assembly, behavior of the telemetry system power, voltage for the bias current on the antenna blades, and voltages of the battery and power supplies. D.E.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-14486# Western Electric Co., Inc., Laureldale, Pa.
PRODUCTION ENGINEERING MEASURE: MECHANIZATION OF SEMICONDUCTOR DEVICES 2N559–2N1094 Quarterly Progress Report, Jul. 1–Sep. 30, 1964
M. N. Reppert [1964] 41 p
(Contract DA-36-039-SC-72729)
(QR-27; AD-609442)

The design and production of high-volume production equipment for use in the manufacture of semiconductor devices (in particular, 2N559 and 2N1094 transistors) is described. Work in the following areas is summarized: (1) ultrasonic wire bonding; (2) the welding of headers; (3) material-handling techniques for reduction in header distortion and contamination; (4) emitter etching assemblies; (5) uniformity in the germanium diffusion process; (6) protective coatings with a jet silane process; (7) an infrared temperature detector; (8) the improvement of wafer processing between slice scribing and wafer bonding; and (9) closed-box germanium diffusion processes. P.V.E.

N65-14495# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
THEORY OF CONTINUOUS ZONE REFINING VIA THE ZONE-TRANSPORT METHOD Physical Sciences Research Papers No. 55
John K. Kennedy and N. Grier Parke, III (Parke Mathematical Labs.) Oct. 1964 20 p refs
(AFCRL-64-844; AD-608781)

This paper explains the differences and the reasons for the differences which exist between the theory of the zone-transport system of continuous zone refining as presented by Pfann and Abe. The identity between the mathematical model used to describe the zone-transport system and one of the models used to describe the recently reported matter-transport system is noted. Nondimensional equations for the zone-transport system are presented, and the difference between the limit of α in the zone-void and zone-transport systems, when $L_e = 0$, is correlated. Author

N65-14594 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL PROOF OF THE ELASTOHYDRODYNAMIC EFFECT
A. V. Kol'chenko 28 May 1964 7 p refs Transl. into ENGLISH from Nauchn. Zapiski, Gos. Nauchn.-Issled. i Proyekinyy Inst. Ugolnoy, Rudnoy, Neftyandy, i Gazovoy Prom. (Kiev), no. 9, 1962 p 24–28
(FTD-MT-64-47; AD-606740)

The creation of bearings of the new elastohydrodynamic type operating on a water lubricant is more effective than the best supports lubricated by oils. A new experimental method of direct measurement of both the hydrodynamic flow rate of the lubricant through the working slot of the bearing and the lateral leaks of the lubricant from the slot is described, and results of the application of this method are listed. The lateral leak is formed at significant hydrodynamic flow rates through the slot of a layer of lubricant of significant thickness. This ensures the work of the bearing with very low friction in a wide range of operating conditions, and also a long period of service. The relief of surfaces of the elastic elements of a sliding block relative to the plane of the disk was explored. The experiment could be carried out successfully only by maintaining necessary accuracy and finish grade of surfaces of specific parts of the stand. R.W.H.

N65-14652*# Electro-Optical Systems, Inc., Pasadena, Calif.
SURFACE ION SOURCE PHENOMENA AND TECHNOLOGY. PART II: POROUS MATERIAL TECHNOLOGY
H. H. Todd and J. M. Teem [1964] 37 p refs Presented to AGARD Combust. and Propulsion Panel, Athens, 15–17 Jul. 1963
(Contracts NAS8-1537; NAS8-2547; AF 33(616)-6958; DA-04-495-ORD-1191)
(NASA-CR-51309) OTS: HC $2.00/MF $0.50

The current status of porous refractory materials technology related to cesium contact ionizers is reviewed from a metallurgical viewpoint. Information is presented concerning ionizer materials requirements; the production of porous materials using wire, sheet, and sintered power methods; a comparison of the metallurgical and ionizer properties of these various materials; methods of joining such porous materials to the nonporous refractory elements of vapor feed systems; and operating problem areas. Author

N65-14656*# Chance Vought Corp., Dallas, Tex. Aeronautics Div.
DEVELOPMENT OF A REINFORCED CARBONACEOUS AND ABLATIVE COMPOSITE FOR ENTRY HEAT PROTECTION OF MANNED SPACECRAFT Quarterly Progress Report No. 1, Jul.–Sep. 1962

F. C. Smith, T. D. Field, Jr., I. E. Harder, J. E. Medford, R. Udlock et al 30 Sep. 1962 115 p refs *Its* Rept.-330.11
(Contract NAS9-576)
(NASA-CR-56324) OTS: HC $4.00/MF $0.75

The purpose is to develop an existing concept for an afterbody heat shield applicable to manned entry spacecraft. The basic concept consists of an outer face layer of porous oxidation resistant reinforced carbonaceous material, and an inner filler layer of gas producing ablative-insulative material. A honeycomb structure contains the ablative material. These materials are attached to each other and the spacecraft skin by bonding and/or mechanical means. Heat protection is provided by radiation of the face material, insulation and ablation of the filler material, and transpiration cooling of the porous face by the escaping gases. Development of the concept requires materials evaluation and selection, development of a thermal computer routine for predicting thermal behavior, and design and testing of prototype heat shield panels. This report discusses the materials and processes selected for fabrication of face and filler test specimens and preliminary test results. The selection of bonding materials and concepts for mechanical attachments is also presented, and the thermal computer routine is discussed. Author

N65-14657*# Aeronca Mfg. Corp., Middletown, Ohio.
DEVELOPMENT OF HIGH STRENGTH, BRAZED ALUMINUM, HONEYCOMB SANDWICH COMPOSITES ADAPTABLE FOR BOTH ELEVATED AND CRYOGENIC TEMPERATURE APPLICATIONS Third Quarterly Report, Jan.–Mar. 1964
B. E. Kramer [1964] 85 p
(Contract NAS8-5445)
(NASA-CR-56305; ER-787) OTS: HC $3.00/MF $0.75

Following screening tests, three experimental brazing alloys were selected for reduction to foil for scale-up brazability tests. Two alloys, 85Zn–14.9Al–0.1Be and 60Zn–39.9Al–0.1 Be were reducible to foil. After the Al–Ge alloy proved unacceptable for foil reduction, 60Zn–40Al–0.1Be was substituted. Test results verify that beryllium additions to zinc–aluminum alloys promote brazability. Using the three successful brazing alloys and various combinations of six facing-sheet and two core materials, sandwich panels were fabricated and coupon samples taken. Results of tensile tests and metallographic examinations are tabulated. E.P.V.

N65-14668# Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
INVESTIGATION OF MODIFIED POSITION, DOWNHAND MIG WELDING OF 2014-T6 ALUMINUM ALLOY
J. Haryung 4 Dec. 1964 22 p
(SM-48366)

Automatic MIG welds were prepared in positions ranging from 0° to 35°, upslope and downslope, using welding procedures closely approximating those used in the production of 2014-T6 aluminum alloy domes. Welds were nondestructively inspected, mechanically tested, and spectrographically analyzed. Variances in the welding position produced marked differences in porosity content and bead geometry but exerted no significant effect upon ultimate tensile properties. Minor differences in weld metal chemistry resulted from changes in the welding position. Dye-penetrant and radiographic inspections disclosed that welds made in upslope positions contained fewer defects than those made in downhill directions. Welds made at upslopes of 15° to 30° contained no internal or surface defects. Author

N65-14704# Reactive Metals, Inc., Ashtabula, Ohio.
QUARTERLY PROGRESS SUMMARY, APRIL–JUNE, 1964
C. A. Scharschu et al 11 Nov. 1964 21 p ref
(Contract AT(30-1)-1405)
(RMI-1)

CONTENTS:

1. INFLUENCE OF BILLET ANNEALING ON THE HOT EXTRUDABILITY OF URANIUM C. A. Scharschu p 2–8 ref
2. PROGRESS REPORT ON THE PIERCING OF NORMAL URANIUM BILLETS FOR THE EXTRUSION OF MARK V-B TUBING C. A. Scharschu p 9–15
3. SUMMARY OF THE DYNAPAK EXTRUSION OF URANIUM TUBES Q. C. Carloni and L. Robins p 16
4. SUMMARY REPORT—FABRICATION OF CUBICAL ITEMS R. F. Kohanski, R. D. Heiser, and Q. C. Carloni p 17

N65-14802*# Stanford U., Calif.
MECHANISMS OF STRENGTHENING AND FRACTURE IN COMPOSITE MATERIALS First Progress Report Jun. 1–Nov. 30, 1964
A. S. Tetelman [1964] 15 p refs
(Grant NsG-622)
(NASA-CR-60123) OTS: HC $1.00/MF $0.50

Titanium carbide dispersed in a nickel–molybdenum matrix has been chosen for a study to determine whether critical tensile stress or strain concentration is required for crack nucleation in composites containing hard particles dispersed in a ductile matrix. Work is now underway on the die design and final determination of test procedures. An iron-3% silicon alloy is being used to see whether mechanically produced cavities can increase the fracture toughness of brittle materials. Fine holes (diameter 200μ or greater) have been drilled into notched and unnotched specimens, prior to testing in tension, bending, and impact. Cylindrically drilled holes have been chosen to investigate the effect of holes on crack nucleation, as well as on propagation. Preliminary results show little effect on net section fracture strength or ductility when the hole size is of the order of the grain size, although the mechanically induced holes seem to effect crack initiation and propagation at the notch root. Formulas for theoretically calculating the criteria for initiating fracture in a two-phase material containing a crack of 2 c length in one phase are also given. M.G.J.

N65-14828# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
HIGH PRESSURE THRUST BEARINGS: AN APPLICATION
R. E. Riecker and D. L. Pendleton Nov. 1964 30 p refs *Its* Instr. Papers No. 52
(AFCRL-64-883; AD-608783)

Successful operation of a 50-kb, 1000°C, rock-deformation shear press depends on frictionless operation of two thrust bearings; an upper bearing must transmit undiminished 30000 in-lb of torque to a mineral test specimen, and the lower bearing must permit free rotation of a torque measuring arm under maximum torques of 7000 in-lb. Upper bearing friction coefficients as low as 0.01 result when colloidal bonded films containing 65% pure MoS_2 in an alkyd resin are used with MoS_2 greases. The torque arm bearing is lubricated with 0.01-inch-thick Teflon sheet to obtain friction coefficients below 0.016. Bearing pressures occasionally exceed 100000 psi in both bearings, however no evidence of galling, seizing, or wear has developed on any thrust plate. Torque losses do not exceed 5% of the transmitted value in the upper bearing and 3.5% in the lower bearing. Author

N65-14834# Union Carbide Corp., Lawrenceburg, Tenn. Carbon Products Div.
IMPROVED GRAPHITE MATERIALS FOR HIGH-TEMPERATURE AEROSPACE USE. VOLUME II: DEVELOPMENT OF GRAPHITE-REFRACTORY COMPOSITES Technical Documentary Report, 1 May 1963–30 Apr. 1964
R. M. Bushong et al Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 143 p refs
(Contract AF 33(657)-11171)
(ML-TDR-64-125, Vol. II; AD-609247)

Studies were conducted on the following composite changes: zirconium, silicon, and niobium replacement of boron; and niobium, cerium, and lanthanum replacement of silicon. Studies of graphite–oxide reactions provided information concerning the stability of oxide coatings in contact with carbon bodies. Insight was gained into the mechanisms of such reactions when their limits of stability are exceeded. A high-temperature apparatus was developed to supplement existing oxidation tests at this laboratory. Cyclic tests of short duration were completed on grade ATJ, SiC-coated RVC, and grade JTA. Additional tests using exposures of 5, 15, 30, and 60 minutes over the temperature range of 1400° to 1800° C were performed on grade JTA. These data were used as a basis for screening new composites. The most oxidation-resistant composite was JT-0981 in which the boron was completely replaced with silicon. Author

N65-14836# Westinghouse Electric Corp., Blairsville, Pa. Materials Mfg. Div.
HIGH ENERGY RATE EXTRUSION Final Report, 23 Sep. 1960–31 Jan. 1964
J. M. Rippel Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 202 p refs
(Contract AF 33(600)-41948)
(ML-TDR-64-312; AD-608945)

Thin structural shapes can now be produced by high-velocity extrusion equipment. Tooling, dies, die coatings, lubricants, and general processing parameters have been developed to produce titanium alloy, stainless steel, low alloy steel, and refractory metal alloy shapes. Extruded Tee sections, 2 by 1 by 0.50 in. thick, have been made in lengths of 10 feet from titanium-6Al-4V, AISI 4340, and 304 stainless steel. These extrusions have uniform surfaces (100 rms or better) and good dimensional tolerances (±0.005 inch). The refractory metal alloys of molybdenum and columbium were made in shorter lengths and generally did not have as good a surface finish or tolerance. Dies coated with 0.010 inch of zirconia and lubricated with graphite proved much superior to conventional tool steel dies resisting wear at extrusion temperatures up to 3200° F. Author

N65-14846# Beryllium Corp., Reading, Pa.
PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES Quarterly Progress Report, Apr. 1–Jul. 31, 1964
J. F. Blum and J. N. Wambold [1964] 38 p
(Contract DA-36-039-AMC-01481(E))
(QPR-4; AD-609686)

Development work has shown that powder varies throughout a large calcination bed. The tops are more sinterable and have a finer particle size distribution than do the bottoms. It was shown that a very uniform powder was obtained from batch to batch in large calcination beds when the total powder from each run was blended to obtain a composite powder for each run. Precompaction was evaluated as a method to increase powder bulk density for better fill and flow properties. The precompacted powder was far superior to the normal powder with respect to these characteristics. However, some preliminary data indicate that the dielectric strength of parts prepared from powder previously precompacted at high pressure (18 000 psi) may be adversely effected. Extrusion development has shown that water soluble starches can replace floc-gel starch as a binder. Some control problems were evaluated. Author

N65-14861# Westinghouse Electric Corp., Newbury Park, Calif. Astroelectronics Lab.
ADVANCED PROCESSING TECHNIQUES FOR CAMERA TUBES Interim Report, Jun.–Sep. 1964
M. K. Kilcoyne and R. S. Florek [1964] 21 p ref
(Contract AF 33(615)-1238)
(IR-2; AD-607503) OTS: $2.00

Of a total of 49 photodiodes started, 24 units were sealed. Eighteen were either of low-sensitivity or leaky. These were reopened, evaluated, and parts reclaimed. Poor photocathode sensitivity attributed to the use of contaminated substrates resulting from gas evolution from the alkali generators during photosurface formation was also examined. Results of evaluation of nine diodes are tabulated, and shelf life characteristics are plotted for five diodes. Data obtained for one diode met all requirements, i.e., transfer and sealing the photosurface in the tube, tube operation for one hour under load, and shelf life of one month. Operation of the tube for 1 hour at 600 volts produced no detectable deterioration in sensitivity. After a shelf life of one month, the loss of response was of the order of 13%. E.E.B.

N65-14864# Joint Publications Research Service, Washington, D.C.
DEVELOPMENT OF MATERIALS FOR NEW TECHNOLOGY
15 Jan. 1965 15 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 10, Oct. 1964 p 69–78
(JPRS-28323; TT-65-30139) OTS: $1.00

The importance of intensive research for developing materials capable of meeting the requirements of new technologies is stressed. Problem areas in which such needs exist include rolling mills, techniques for processing structural materials by concentrated energy flow, properties and structures of refractory and hard compounds, metallochemistry and development of new inorganic materials, and increased structural strength in multi-element materials. Mention is made of accomplishments to date but main emphasis is placed on the problems still to be solved. M.G.J.

N65-14924# Reactive Metals, Inc., Seymour, Conn.
SUMMARY OF THE DYNAPAK EXTRUSION OF URANIUM TUBES
Q. C. Carloni and L. Robins 11 Sep. 1964 31 p refs
(Contract AT(30-1)-1405)
(BRB-83)

The program to develop the high energy rate extrusion process for uranium tubes is summarized. The Model 1800 horizontal DYNAPAK machine was employed. A description of a possible DYNAPAK extrusion production plant and rough estimates of the installation and operational costs are presented. The DYNAPAK extrusion has been successfully employed to produce single-slug length tubes of the Mark VB-0 and I&E sizes, relatively thin- and thick-walled tube types, respectively. Double-slug length I&E tubes were produced in quantity under production test conditions, however, there was a warpage problem. The model 1800 machine did not possess sufficient energy to fully extrude the double-slug length Mark VB-0 tube. Author

N65-14928# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

AN ANALYSIS OF THE TRAILING-EDGE EFFECT IN SLIDER AND PARTIAL ARC GAS-LUBRICATED BEARINGS Interim Report

H. G. Elrod, Jr. and J. T. Mc Cabe Dec. 1964 18 p refs

(Contract Nonr-2342(00))

(I-A2049-22; AD-609086)

This report analyzes the behavior of the pressure distribution within partial-arc and slider bearings under conditions of high-speed operation. It was shown: (1) In high-speed operation most of the bearing simply acts as a viscous pump, with its gas output expanding to ambient through a short region near the trailing edge. (2) The point of maximum pressure is a point of transition. Upstream of this point the pressure deviates from the infinite lambda value ($p = p_a\ h_1/h$) by an amount of order ($1/\Lambda$). Downstream of this point the pressure drops rapidly to ambient pressure through a distance of order ($1/\Lambda$). (3) Numerical values for the dimensionless pressure function PH/K can be found. (4) Values obtained from the present asymptotic analysis agree well with those of Gross and with those of McCabe. Author

N65-14943# General Motors Corp., Indianapolis, Ind. Allison Div.

APPRAISAL OF TECHNICAL PROBLEMS RELATED TO LARGE, THIN WALL TITANIUM PRESSURE VESSELS

G.L. Vonnegut, G. R. Sippel, and D. K. Hanink [1964] 51 p refs Presented at joint ASM-ASTME Western Metal and Tool Conf., Los Angeles, 16–20 Mar. 1964

Principal technical information is presented on the strength and fracture toughness properties of TIG welds in Ti-6Al-4V. These were evaluated and found to be satisfactory when commercially pure filler wire was used. A crack initiation test was developed for determining the biaxial ductility of weld joints. This test is sensitive to small amounts of contamination which might be produced during welding. The effect of processing variables on the strength and fracture toughness of Ti-6Al-4V full-scale missile case forgings was evaluated. These processing variables included section thickness during solution treatment, solution temperature, aging temperature and time, as well as shear spinning. Comparisons of Ti-6Al-4V with 18% Ni-CoMo maraging steel and with D6AC hot work die steel with respect to strength–density ratio and fracture toughness showed Ti-6Al-4V to be superior in the presence of partial thickness fatigue cracks less than 0.150-in. long. At crack lengths over 0.200-in., all three materials are equally competitive. Author

N65-14955*# Kaiser Refractories, Milpitas, Calif. Research Div.

A STUDY TO DEVELOP A MAGNESIUM OXIDE MATERIAL FOR STORAGE HEATERS Progress Report No. II, 1 Sep.–31 Oct. 1964

W. R. Alder [1964] 3 p

(Contract NAS2-2114; K/R Proj. ARC-100)

(NASA-CR-60157) OTS: HC $1.00/MF $0.50

Ball-milled sintered magnesia of several different purity levels and calcined magnesia were pressed into right cylinders and fired to 1700° C for 6 hours. Standard tests to determine the comparative mechanical properties of these materials were run, and the results are summarized. Development of a laboratory method for granulating magnesia and fabrication of various shapes are also briefly covered. Author

N65-14963# Witwatersrand U., Johannesburg (Union of South Africa).

MATERIAL CUTTING RESEARCH—A BIBLIOGRAPHY

Maryna Bosman, comp. Nov. 1964 109 p refs

(Rept.-22)

N65-15017*# Stanford Research Inst., Menlo Park, Calif.

STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. 2, 1 Jun.–1 Sep. 1964

F. A. Halden 15 Oct. 1964 12 p refs

(Contract NASr-49(19); SRI Proj. PMU-4892)

(NASA-CR-60134) OTS: HC $1.00/MF $0.50

Major effort was devoted to establishing specific crystal growth equipment requirements and to constructing experimental facilities capable of providing the desired degree of flexibility under operating conditions. Construction of most of the basic furnace units and manipulations systems for initial studies was completed, and exploratory tests were started. Machining work on the resistively heated annealing furnace was completed, and assembly of components has been started. Stable torch operation was obtained over extended periods, using the rf plasma contained in a water-cooled tube. A successful two-electrode arc melting configuration was completed. Author

N65-15024# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

PREPARATION OF ELECTRON FRACTOGRAPHY HANDBOOK Fifth Quarterly Progress Report, 16 May–15 Aug. 1964

V. Kerlins, A. Phillips, and B. V. Whiteson Aug. 1964 131 p refs

(Contract AF 33(657)-11127)

(SM-44650, Vol. V; AD-446631)

Electron fractography techniques are described along with the approaches to fractography analysis, the treatment of fractures, and guides to distinguish false or artifact structures. Features of fractures are defined and illustrated in such a way that there is no reference to terms such as ductile, brittle, stress corrosion, overload, etc. The fractures found in the "engineering" metals are considered under the following classifications: (1) transgranular—microvoid coalescence, or cleavage, or fatigue; and (2) intergranular fracture—grain boundary separation with and without microvoid coalescence. P.V.E.

N65-15085# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.

DEVELOPMENT OF JOINING TECHNIQUES FOR TD-NICKEL Interim Progress Report No. 2-8-211, 1 Aug.–31 Oct. 1964

T. K. Redden et al [1964] 77 p refs

(Contract AF 33(615)-1403)

(DM-64-443; AD-451101)

A primary goal of the project is the selection and optimization of techniques which will provide a joint without a loss in the strengthening effect of the thoria dispersion in the joint area. The joining methods studied were: resistance welding, diffusion bonding by resistance heating, flash welding, brazing, and diffusion bonding by hot pressing. The evaluation methods for each of the processes is described and the results are discussed. The most promising processes were selected for further study. The selection was based on joint microstructural appearance and integrity and on the joint efficiency achieved at temperatures to 2400° F. The applicability of the selected joining techniques to the joining of jet engine parts was also given strong consideration. Author

N65-15088# Weston Instruments, Inc., Newark, N.J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, 1 Jun.–31 Aug. 1964
T. Matley and R. E. Busch [1964] 25 p
(Contract NObsr-87542)
(IDR-8; AD-607989)

A comparison of alumina with quartz porous substrates with respect to heat dissipation was inconclusive. The absence of intercommunicating porosity in the central portion of the alumina substrates prevented proper metallization. Temperature gradient data have been found very useful in appraising the quality of the terminals nondestructively. A resistance shift (hysteresis) is evident upon electrical loading. The magnitude of the shift is beyond that which can be explained by temperature and/or voltage coefficients. Resistance hysteresis is still marked in resistors made from substrates with the most uniform structural properties. Author

N65-15096# International Resistance Co., Philadelphia, Pa.
PRECISION VOLUME RESISTOR Final Development Report, 18 Jun. 1963–18 Dec. 1964
C. Huang and K. M. Merz 18 Dec. 1964 117 p
(Contract NObsr-89439)
(AD-609623)

An investigation has been completed on materials and fabricating techniques capable of producing a precision volumetric resistor composed of inorganic materials. Performance results indicated these resistors are stable to voltage, temperature, moisture, and other test environments. The high-temperature deposition of carbon into a porous ceramic has been found to produce resistors with excellent properties. This method, however, is useful for only very low range resistors (2.7Ω to 50Ω) because it results in a large negative temperature coefficient of resistance when it is used to produce high resistance values. Resistors based on palladium dispersed in a ceramic matrix have been found to be satisfactory and to cover the resistance range of 100Ω to 100 000Ω. Termination methods for the solid slugs were investigated. An electroless Cu-plating process was found satisfactory for low range deposited carbon resistor, and with some modification it was found acceptable for palladium–ceramic resistors. Author

N65-15113# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GOST 2246-60, STEEL WELDING WIRE
19 Oct. 1964 13 p Transl. into ENGLISH of the publ. "GOST 2246-60 Provoloka Stal'naya Svarochnaya" Moscow, SSSR Gos. Standart, 1961 p 1–8
(FTD-TT-64-378/1; AD-607902)

Measurement tables and technical specifications for various welding steel wires are presented together with the permissible deviations from these standards. Inspection methods, packing, marketing, storage, and transportation procedures are outlined. G.G.

N65-15178 Joint Publications Research Service, Washington, D.C.
PRELIMINARY RESULTS IN STUDYING EXPLOSION FORMING TECHNIQUE
In its Transl. on Communist Chinese Sci. and Technol., No. 133 8 Jan. 1965 p 16–18 Transl. into ENGLISH from Jen-min Jih-pao, (Peiping), 12 Nov. 1964 p 2 (See N65-15176 05-34)
OTS: $2.00

The progress of Communist Chinese technology in discovering methods of explosive forming is described. The trial manufacture of metallic diaphragms for use in audio communications equipment is reported. D.E.W.

N65-15179 Joint Publications Research Service, Washington, D.C.
AN AUTOMATIC EQUALLY IONIZED ARC CUTTER
In its Transl. on Communist Chinese Sci. and Technol., No. 133 8 Jan. 1965 p 19 Transl. into ENGLISH from Pei-Ching Jih-pao, (Peiping), 11 Oct. 1964 p 1 (See N65-15176 05-34)
OTS: $2.00

A flame cutter for stainless steel, aluminum or other high-melting metals is described. In it, a neutrally ionized flame is produced, whose temperature is considerably higher than that of the oxy-acetylene flame. D.E.W.

N65-15181 General Motors Corp., Indianapolis, Ind. Allison Div.
ELECTRON BEAM WELDING—APPLICATIONS AND DESIGN CONSIDERATIONS FOR AIRCRAFT TURBINE ENGINE GEARS
N. F. Bratkovich, W. L. Mc Intire, and Robert E. Purdy *In its* Allison Res. and Eng., Vol. No. 4, Fourth Quarter 1964 [1964] p 2–9 (See N65-15180 05-25)

Design improvements made possible by the use of electron beam (EB) welding allow the use of the best functional material for each precision component without the distortion of other welding processes or the use of cumbersome fastening parts. Examples are given of the way in which the use of EB welding can improve the design of such precision turbine components as double helical gears, cluster gears, and shaft gears. Basic requirements obtain minimum distortion and good quality are discussed and the processing of EB welded gears is described. It was found in metallurgical examination of EB welds in AMS 6265 material that the hardness in the weld zone is comparable to the parent metal hardness and no localized zones of high hardness are induced. Mechanical properties are comparable to or better than welds made with other fusion welding processes. R.L.K.

N65-15185*# Astro-Space Labs., Inc., Huntsville, Ala.
FEASIBILITY STUDY AND DEVELOPMENT OF A RELIABLE AND ACCURATE COMMON BULKHEAD CORRECTIVE MEASUREMENT SYSTEM, VOLUME I, PHASE I Final Report
R. C. Martin and C. E. P. Green [1964] 29 p
(Contract NAS8-11404)
(NASA-CR-60212; ASL-U-64-32) OTS: HC $2.00/MF $0.50

Described is a feasibility study on the design and development of a reliable high-precision measurement system. This system was to perform three-dimensional contour measurements of the forward and aft skins of the Saturn S-II common bulkhead for the purpose of driving a digitally programed milling machine to cut accurate double-mating curvature surfaces of fiberglass-honeycomb-fill segments within a tolerance range of ±0.005 in. Experiments proved the feasibility of such measurements and their accuracy within the required tolerances. The system used the ultrasonic echo measuring technique. Equipment, control circuits, and operation of the system are summarized, and specification and operation sheets from component manufacturers are given. D.E.W.

N65-15192*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT OF THE REBOUND CANISTER OPENING FLANGE

H. de la Puente and D. H. Lynch Mar. 1962 105 p refs
(Contract NAS5-1294)
(NASA-CR-60236; SM-41800) OTS: HC $4.00/MF $0.75

The development effort consisted of tests to (1) evaluate various canister mating bands that could withstand the structural loads to be imposed on the canister, (2) determine an optimum flange cross section that would withstand the impulses exerted by various weight shape charges during separation, (3) evaluate the efficiency of a piston-type flange configuration, and (4) determine the optimum flange cross section with detonation-charge configurations that would satisfy all parameters. It is concluded that the piston-type flange configuration, separated by the pressures created by a mild detonating fuse of 5 grains per foot, will satisfy all the parameters considered. Author

N65-15245# Pennsylvania U., Philadelphia. Moore School of Electrical Engineering
INTERFERENCE SUPPRESSION STUDIES: NOISE AND INTERFERENCE MONITORING STUDIES, VOLUME III Final Report
S. Srikantan Griffiss AFB, N.Y., RADC, Oct. 1964 85 p refs
Its Rept.-64-25, Vol. III
(Contract AF 30(602)-2888)
(RADC-TDR-355, Vol. III; AD-609078)

The report is concerned with the establishment of a signal density monitoring facility. The facility, which is designed to measure ambient noise and signal densities over the frequency range from 100 Mc to 20 Gc, is described from a block diagram point of view. Two other studies of various parameters and equipment which affect the operation of the facility are included. The first concerns a study of the effect of AGC circuitry on the output of an rf noisemeter when the input signal is not a continuous function of time. The study has both theoretical and experimental aspects. An equivalent circuit for the noisemeter is derived and programed on an analog computer. The second study is concerned with various noisemeter output circuits and the effect of receiver bandwidth. Author

N65-15258# Iowa State U. of Science and Tech., Ames. Ames Lab.
ELECTROPOLISHING THE RARE-EARTH METALS
D. T. Peterson and E. N. Hopkins Oct. 1964 14 p refs
(Contract W-7405-ENG-82)
(IS-1036)

This paper describes a method whereby the rare-earth metals can be consistently electropolished and chemically etched. The method involves cooling an alcohol-perchloric electrolyte to −76° C before electropolishing. The metals are chemically polished in the same solution. Author

N65-15261# Joint Publications Research Service, Washington, D.C.
CASTING OF REFRACTORY METALS
B. B. Gulyayev, O. N. Magnitskiy, and A. A. Demidova 15 Jan. 1965 283 p refs Transl. into ENGLISH of the book "Lit'ye Iz Tugoplavkikh Metallov" Moscow, Mashinostroyeniye Publishing House, 1964 p 3–192
(JPRS-28330; TT-65-30143) OTS: $7.00

CONTENTS:

1. GENERAL CHARACTERISTICS OF REFRACTORY METALS p 1–29 refs

2. REACTION OF REFRACTORY METALS WITH A SURROUNDING MEDIUM AT HIGH TEMPERATURES p 30–105 refs

3. EQUIPMENT FOR MELTING AND POURING REFRACTORY METALS p 106–176 refs

4. TECHNOLOGY OF MANUFACTURING REFRACTORY METAL CASTINGS p 177–266 refs

5. PROPERTIES OF ALLOYS ON THE BASIS OF REFRACTORY METALS p 267–309 refs

N65-15283# Atlantic Research Corp., Alexandria, Va.
CASTABLE CARBON FOR NOZZLE APPLICATIONS Third Quarterly Progress Report, Sep. 1–Dec. 1, 1964
James D. Batchelor Dec. 1964 18 p
(Contract AF 04(611)-9718)
(AFRPL-TR-64-183; AD-609607)

The first subscale nozzle (for the 5000-lb-thrust motor) was motor tested. This nozzle indicated excellent performance for the expansion cone, the insert backup piece, and entrance backup piece of castable carbon. The expansion cone erosion rate ranged from about 0.8 to 1.2 mils/sec; this performance was reported to be superior to any other cone tested in the 5000-lb-thrust motor. Substantial erosion occurred, however, on the castable carbon entrance section. The second subscale nozzle, a reentrant design, was almost completed. Author

N65-15292# Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Quarterly Report, 1 Jul.–30 Sep. 1964
John R. Williams [1964] 26 p
(Contract DA-36-039-AMC-01483(E))
(QR-5; AD-609596)

Improvements in oxidation of slices, in boron diffusion of slices, in mask alinement, in etching of slices, in die-to-header bonding, in wire bonding, and in packaging were incorporated into the production process. Progress is reported in detail for the life test racks, the production run authorization, the IBM data collection and analysis system, and test plans for field effect transistors. D.E.W.

N65-15380*# Electra Mfg. Co., Independence, Kan.
ACCELERATION FACTOR DETERMINATION FOR METAL FILM RESISTORS Quarterly Progress Report No. 2, 15 Mar.–15 Jun. 1964
[1964] 18 p
(Contract NAS8-11076)
(NASA-CR-60317) OTS: HC $1.00/MF $0.50

The method of significant difference was used in an analysis of variances in the screen test data and in the temperature-power stress tests. Matrix conditions for the life test were also determined. Author

N65-15381*# Booz-Allen Applied Research, Inc., Bethesda, Md.
RELIABILITY VARIATION ANALYSIS FOR SPACE SYSTEM DEVELOPMENT
R. L. Madison, P. Gottfried, and G. Ronald Herd Nov. 1963 144 p
(Contract NASw-643)
(NASA-CR-60315) OTS: HC $4.00/MF $1.00

General considerations and techniques for space systems reliability evaluation are discussed in the following topics: *New Reliability Control Techniques, Reliability Variation Analysis, Potential of RVA Techniques, Nature of the Problem, The Determination of Reliability Risks,* and *Resources Allocation for Reliability Testing.* Appendixes include: *Mathematical Derivations; An Example: Determining Development Risks and the Allocation of Testing,* and *Failure Rate Variability Model.* G.G.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-14982# Ohio State U. Research Fondation, Columbus. Antenna Lab.
CHARACTERISTICS OF VISIBLE DISCHARGES INDUCED IN GASES BY FOCUSED RUBY LASER PULSES
R. G. Tomlinson (Ph.D. Thesis) 1 Sep. 1964 108 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-14; AD-449441)

The focused radiation from a high brightness laser can produce power densities which result in sufficient ionization in gases to cause breakdown in the form of visible discharges. A high brightness, Q-switched ruby laser was constructed and used to study the characteristics of these visible discharges. Data were taken in krypton, argon, helium, neon, air, nitrogen, oxygen, methane, and carbon dioxide as a function of pressure and laser power density. Focusing lenses with 3-cm and 1.2-cm focal lengths were employed. A comparison of the experimentally determined laser ionization rates with the microwave ionization rates was made through the scaling factor, effective electric-field strength. The laser-induced ionization rates were much greater than the microwave ionization rates, indicating a more efficient energy coupling mechanisms. When threshold conditions were exceeded the density of free electrons in the gas grew rapidly in a cascade process to produce a visible breakdown plasma and shock wave. Author

N65-15207 United Aircraft Corp., East Hartford, Conn. Research Labs.
ULTRASONIC CONTROL OF LASER PERFORMANCE Final Report, Jun. 26, 1963–Jun. 25, 1964
A. J. De Maria and G. E. Danielson, Jr. 25 Sep. 1964 33 p refs
(Contract DA-19-020-AMC-0170(A))
(C-920083-12; AD-605940)

The laser is represented in terms of a system block diagram having forward and feedback transfer functions which can be varied in a periodic manner so as to modulate the output of the quantum device. The modification of a laser's feedback transfer function by an ultrasonic refraction and by an optical-tunnelling shutter has been utilized to gate the laser's output. Experiments are reported which demonstrate that the periodic fluctuation of the refractive index resulting from the propagation of focused ultrasonic energy within a solid-state laser medium can be utilized as a Q-spoiler to gate the output of high gain lasers without the introduction of lossy elements into the laser's feedback path. In addition, experiments are reported which reveal an increase in the energy output of a neodymium-doped lanthanum thorium borate glass rod when longitudinal acoustical standing waves were propagated down the length of the glass rod. Author

N65-15259# Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
INVESTIGATION OF OPTICAL FREQUENCY TRANSLATION TECHNIQUES
J. K. Sharp, E. O. Vaher, and E. W. Cheatham, ed. Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 72 p
(Contract AF 33(657)-11653)
(AB-1272-0013; AL-TDR-64-226; AD-607700) OTS: $3.00

Various techniques of optical frequency translation were investigated, leading to the design of a V-shaped laser configuration that can simultaneously support independent oscillations having two separate polarizations. The device consists of two laser cavities sharing a single neodymium-doped glass laser rod and end mirror. Theoretical and experimental studies of mode selection techniques and Fabry–Perot interferometric analyzers are presented. This work leads to single-mode operation for each separate frequency and to effective methods of measuring translation. Tuning a single leg of the Y laser, translation over a total range of 18 Gc was achieved. Observation of simultaneous operation of both legs was also made. It was concluded that the method selected was feasible and that further effort is warranted. Author

N65-15309# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
PERFORMANCE OF NON-IDEAL NARROWBAND QUANTUM COUNTERS
W. F. Krupke 30 Oct. 1964 59 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-241; TDR-269(4250-25)-2; AD-417484)

Narrowband quantum counters with less than unit internal quantum efficiency are analyzed. The pump power dependent expressions for the transient and steady-state quantum efficiencies are derived. These quantities are discussed for typical trivalent and divalent rare-earth-doped insulator crystals, and the performance of two specific systems is presented. To achieve high quantum efficiency in trivalent rare-earth-doped quantum counter systems, the pump source must be highly nonblackbody in spectral character (i.e., a laser) and resonant with the transition between the relevant excited states. Performance limiting factors for laser-pumped quantum counters are pointed out. A rare-earth-doped semiconductor quantum counter system which generates a conduction current output by absorption of a signal and pump quantum is proposed and analyzed. A discussion of several noise current mechanisms, not present in insulator-fluorescing quantum counters, is given, and the performance of a semiconductor quantum counter is presented. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-14558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANICAL PROPERTIES OF ARC-MELTED AND ELECTRON-BEAM-MELTED TUNGSTEN-BASE ALLOYS
Peter L. Raffo, William D. Klopp, and Walter R. Witzke Washington, NASA, Jan. 1965 22 p refs
(NASA-TN-D-2561) OTS: HC $1.00/MF $0.50

The effects of selected alloying elements on the high-temperature creep and tensile strength and the ductile-brittle transition behavior of arc- and electron-beam-melted tungsten were investigated. The tensile and creep strength of arc- and electron-beam-melted tungsten above 2500° F were significantly increased, in order of decreasing effectiveness, by additions of boron, hafnium, tantalum, columbium, and rhenium. Additions of 2.11 and 6.64 atomic percent rhenium to electron-beam-melted tungsten resulted in bend-transition temperatures below room temperature in the stress-relieved condition compared with 180° to 250° F for unalloyed arc- and electron-beam-melted tungsten. Author

N65-14567*# National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTION TO THE STUDY OF THE PLASTICITY OF SINTERED ALUMINUM POWDER (SAP) [CONTRIBUTION A L'ETUDE DE LA PLASTICITE DU SAP]
P. Guyot Jan. 1965 22 p refs Transl. into ENGLISH of EURATOM Rept. No. EUR-550.f Presented at the Journées Métallurgiques d'Automne, Paris, 14–18 Oct. 1963
(NASA-TT-F-9228; EUR-550.f) OTS: HC $1.00/MF $0.50

The deformation mechanism of SAP, with various alumina contents, was investigated on the basis of deformation kinetics, evolution of the alumina phase with temperature, determination of the activation energy, structural tests by X-ray and electron microscope, etc. At temperatures below 300° to 350° C, the deformation mechanism of SAP is similar to that of polycrystalline aluminum. Up to 100° C, the dislocations can bypass or overcome by deviation the obstacles of alumina particles. The dislocations in the (111) plane avoid the particles by deviation into the $(\bar{1}10)$ and (110) directions, possibly under formation of prismatic loops. At temperatures above 200° C, there is a creep of dislocations with formation of residual rings around the particles. At temperatures above 350° C, the interparticle spacing, or the alumina percentage, determines the mechanism. The escape energy for dislocations is calculated. Author

N65-14586 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Seventh Quarterly Report, 1 Jan.–31 Mar. 1964
Willard H. Sutton Mar. 1964 22p refs
(Contract DA-36-034-ORD-3768(Z))
(AMRA-CR-63-01/7; AD-607984)

The effects of various additives to nickel on its wetting and adherence to sapphire ($\alpha-Al_2O_3$) were investigated by preparing special binary alloys containing 1 atomic percent of Al, Cu, In, Ti, Zr, and Cr. Sessile drop experiments were conducted in vacuo (5×10^{-6} torr) at 1480° to 1500° C in order to observe the contact angles and the degree of wetting. Shear tests were conducted on the solidified sessile drops of nickel. Values as high as 25 000 psi were recorded for the nickel drop containing chromium. Author

N65-14596# Rutgers U., New Brunswick, N.J. Materials Research Lab.
THE EFFECT OF LOW-TEMPERATURE ANNEAL IN COPPER-BASE Second Technical Report
K. Nakajima, J. J. Slade, and J. Weissmann Sep. 1964 34p refs
(Contract DA-ARO(D)-31-124-G300)
(AROD-35605; AD-447522)

The low-temperature annealing of quenched copper–aluminum and copper–germanium alloys with low stacking-fault energy, γ, was studied by a novel combination method. This method consists of transmission electron microscopy supplemented by the X-ray divergent beam technique. With the aid of the latter method, a complete quantitative stress–strain analysis was carried out for every annealing stage. It was shown that short low-temperature annealing resulted in an increase of γ. This increase was accompanied by: (1) a recombination of partial dislocations into perfect dislocations; (2) a decrease in stored elastic energy; and (3) a directional alinement of single and dipole dislocations. Prolonged annealing led to cluster formation of solute atoms to the sites of perfect dislocations. Author

N65-14609*# National Aeronautics and Space Administration, Washington, D.C.
BLOCKING OF DISLOCATIONS IN ALLOYS OF THE SAP/Al-Al_2O_3 TYPE [BLOCAGE DES DISLOCATIONS DANS LES ALLIAGES DU TYPE SAP/Al-Al_2O_3]
P. Guyot Jan. 1965 16 p refs Transl. into ENGLISH of EURATOM Rept. No. EUR-584.f, Feb. 1964 13 p Previously announced (In FRENCH) as N64-20877 14-25
(NASA-TT-F-9229; EUR-584.f) OTS: HC $1.00/MF $0.50

The escape energy of a dislocation, blocked by particles or precipitations dispersed in a metallic matrix, was studied and compared with experimental data of the activation energy in sintered aluminum powder (SAP). Electron-microscope microstructure models and equations for the critical escape energy of the dislocations are given. Apparently, a region intermediate between two mechanisms is involved in the blocking of dislocations by precipitations or segregations—deviation and blocking or creepage and blocking. At high temperatures, there is a tendency toward a blocking–deblocking mechanism of the dislocations by alumina particles. Author

N65-14670# Iowa State U. of Science and Tech., Ames.
THE CREEP OF THORIUM NEAR ROOM TEMPERATURE
D. T. Peterson and J. D. Young Sep. 1964 24 p refs
(Contract W-7405-ENG-82)
(IS-986) OTS: $2.00

The rate of plastic deformation of thorium has been investigated as a function of stress and strain at temperatures from 0° to 60° C. The rate of creep or plastic deformation was found to depend on the instantaneous values of the stress, strain, and temperature and thus could be expressed by a mechanical equation of state. The yield point phenomenon was observed even at the lowest plastic strain rates. A critical stress was found below which no plastic deformation was observed. Author

N65-14675# Bettis Atomic Power Lab., Pittsburgh, Pa.
HYDROGEN ABSORPTION IN ZIRCALOY DURING AQUEOUS CORROSION, EFFECT OF ENVIRONMENT
E. Hillner Nov. 1964 43 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-411) OTS: $2.00

An interpretive literature survey, supplemented with more recent laboratory evaluations, was made of the effects of various environmental factors on the aqueous corrosion and hydrogen absorption characteristics of zircaloy. Relatively small quantities of dissolved oxygen were shown to affect a substantial decrease in hydrogen pickup although the oxidation kinetics are affected slightly. Extensive quantities of dissolved hydrogen are required to produce a noticeable increase

in hydrogen pickup without adversely affecting the corrosion process. A mechanism for hydrogen incorporation into the oxide during normal corrosion was postulated, and the specific effects of oxygen and hydrogen in the environment on hydrogen pickup were explained on the basis of the perturbations imposed upon the normal situation. Author

N65-14687# Atomic Energy of Canada Ltd., Chalk River, Ontario.
HYDROGEN DISTRIBUTION IN OXIDIZED ZIRCONIUM ALLOYS BY AUTORADIOGRAPHY
C. Roy Sep. 1964 39 p refs
(AECL-2085) Available from Atomic Energy of Canada, Chalk River: $1.00

Specimens of zirconium alloys were encapsulated with carrier-free tritium in the form of hydrogen gas or water, then held at controlled temperatures for predetermined times. Subsequent autoradiographs clearly mapped the hydrogen distribution and showed segregation even when a hydride phase was not readily observed metallographically. In the metal, the hydrogen has been observed (under certain conditions) to be more heavily segregated at grain boundaries than in the bulk, even with samples quenched as rapidly as the method of preparation permitted. In oxides less than 1 micron thick grown in T_2O, an apparent grain-to-grain correlation existed between the oxide thickness and the amount of hydrogen. In pretransition oxides preformed in oxygen and then treated in T_2O, the hydrogen distribution appeared uniform and the concentration exceeded that in their metal substrates by at least a factor of ten. Hydrogen segregation was apparent in posttransition ides on Zircaloy-2; the substrates revealed high hydrogen absorption. Author

N65-14749# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ALLOYING ELEMENTS ON THE PROPERTIES OF STEEL
M. P. Braun 24 Aug. 1964 199 p refs Transl. into ENGLISH of the book "Vliyaniye Letiruyushchikh Elementov Na Svoystva Stali" Kiev, Gos. Izd. Tekhn. Lit. USSR, 1962 p 1–192
(FTD-MT-63-271; AD-607126)

CONTENTS:

1. THE EFFECT OF ALLOYING ELEMENTS ON THE TENDENCY OF STEEL TO BRITTLE FRACTURE p 3–19
2. THE SEPARATION OF CARBIDES DURING TEMPERING AND FORCES ON CONNECTION BETWEEN CARBON AND ALLOYING ELEMENTS p 20–24
3. THE GROWTH OF A GRAIN AND THE CHARACTER OF FRACTURE OF STEELS p 25–57
4. THE INFLUENCE OF ADDITIONAL ALLOYING ON THE TRANSFORMATION OF AUSTENITE SILICON-MANGANESE STEEL p 58–72
5. MAIN MECHANICAL AND TECHNOLOGICAL PROPERTIES OF LOW-ALLOY STEELS p 73–126
6. THE EFFECT OF MODIFYING ADDITIONS UPON THE MECHANICAL PROPERTIES AND FRACTURE STRUCTURE OF CAST ALLOY STEEL p 127–135
7. MECHANICAL PROPERTIES OF STEEL IN PRODUCTS OF LARGE CROSS SECTIONS p 136–173
8. APPLICATION OF HIGH STRENGTH LOW-ALLOY AND LARGE-SCALE-ALLOY STEELS p 174–190

N65-14789# Yale U., New Haven, Conn. Hammond Lab.
X-RAY STUDY OF DEFORMATION OF Nb-Re ALLOYS
E. N. Aqua and C. N. J. Wagner Apr. 1964 23 p refs
(Contract Nonr-609(43))
(TR-9; AD-603473)

The bcc alloys of the terminal solid solution of rhenium in niobium were investigated by X-ray diffraction methods, supplemented by microhardness measurements. The hardness was found to increase almost linearly with rhenium percentages. The analysis of the broadening of the powder pattern peaks from the Nb-rich alloys, cold worked by filing, showed evidence for stacking faults and/or twin faults. The alloys with larger rhenium concentrations were brittle and fractured when attempting to file. The analysis of the shapes of the diffraction profiles from powders of these brittle alloys (produced by hammering with steel plates) indicated that the broadening was due predominantly to platelets bounded by cube planes. This result was consistent with the data from (1) integrated intensity measurements and (2) Laue patterns from single cleavage facets which showed evidence for cleavage fracture on {100} planes. Author

N65-14816# Joint Publications Research Service, Washington, D.C.
PRODUCTION OF HEAT-RESISTING ALLOYS
F. F. Khimushin 14 Jan. 1965 30 p refs Transl. into ENGLISH of part 6 from the book "Zharoprochnyye Stali i Splavy" Moscow, 1964 p 633–655
(JPRS-28309; TT-65-30134) OTS: $2.00

Four main areas are covered: melting and pouring methods, casting technology, hot working, and heat treatment and welding. The effects of various melting methods are discussed, and the melting of high-temperature alloys in electric-arc furnaces and in vacuum furnaces is described. The technology of casting precision parts from heat-resisting steels and alloys is considered, including the historical aspects, and such details as pattern waxes, ceramic coatings, types of alloys, elemental losses from alloy melts, oxidative losses, inclusions, mold design, structural steel casting, and nozzle blade casting. The hot working of steels and alloys is discussed in terms of temperatures of working, recrystallization schemes, low-melting eutectics, cracking, and terminal temperature during working. Techniques of heat treatment are described, and the welding of oxidation-resistant and heat-resistant steels and alloys is discussed in detail. D.E.W.

N65-14832# Republic Aviation Corp., Farmingdale, N.Y.
RESEARCH INVESTIGATION TO DETERMINE MECHANICAL PROPERTIES OF NICKEL AND COBALT-BASE ALLOYS FOR INCLUSION IN MILITARY HANDBOOK-5, VOLUME I Technical Documentary Report, Apr. 1961–Jun. 1964
A. Greene, H. Sieber, D. Wells, and T. Wolfe Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 525 p refs
(Contract AF 33(657)-8924)
(ML-TDR-64-116, Vol. I; AD-608813)

Design information on four nickel and cobalt base alloys was developed. The alloys investigated were René 41, L-605, Inconel 702, and Incoloy 901. The mechanical properties investigated were tensile, compression, shear, bearing, creep, stress-rupture, and fatigue. The general results obtained and the data generated are presented. Author

N65-14833# Republic Aviation Corp., Farmingdale, N.Y.
RESEARCH INVESTIGATION TO DETERMINE MECHANICAL PROPERTIES OF NICKEL AND COBALT-BASE ALLOYS FOR INCLUSION IN MILITARY HANDBOOK-5, VOLUME II Technical Documentary Report, Apr. 1961–Jun. 1964

A. Greene, H. Sieber, D. Wells, and T. Wolfe Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 698 p For abstract see N65-14832 05-17
(Contract AF 33(657)-8924)
(ML-TDR-64-116, Vol. II; AD-608846)

N65-14999# Midwest Research Inst., Kansas City, Mo.
THE STRUCTURE AND STRENGTH OF EPITAXIAL FILMS Bimonthly Progress Report, 17 Jun.–17 Aug. 1964
Paul J. Bryant, Melvin Lavik, and Paul Stablein 25 Sep. 1964 5 p
(Contract NOw-64-0061-d)
(BMPR-5; AD-605850)

The main effort has been the design of a tensile device to facilitate stress–strain measurements on free epitaxial films and the development of techniques for removing the substrate from such films. In addition, the evaporation oven has been rebuilt so that only the inner wall of the crucible is exposed to UHV. Lower operating pressures may now be maintained during evaporation. Gold films have been deposited on aluminum, silver, sodium chloride, and mica crystals and their structure is being studied. Author

N65-15006# California U., Berkeley. Metal Processing Lab.
VISIOPLASTICITY Progress Report, 1 Jun.–30 Sep. 1964
T. Altan, A. Shabaik, and E. G. Thomsen Sep. 1964 9 p
(Contract NOw-63-0564-D)
(PR-2; AD-609947)

Visualization methods for observing stress and mass flow in the extrusion and rolling of lead billets are described. Two methods of velocity determination are discussed. An experimental program was initiated to furnish data for modifications to a computer model of plain strain flow field to bring it into closer agreement with actuality. A new 75-ton hydraulic press for plastic flow studies is described. E.P.V.

N65-15041# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
MECHANICAL PROPERTIES OF METALS Review of Recent Developments
J. E. Campbell 15 Jan. 1965 4 p refs

Low-temperature properties of notched specimens and plates of new high-strength steel alloys are reviewed, with emphasis on their fracture toughness, plastic deformation under rapid heating, and stress-induced fatigue. G.G.

N65-15047# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
SHOT PEENING EFFECTS ON THE FATIGUE PROPERTIES OF CHROMIUM PLATED HIGH STRENGTH STEEL FOR USE AT TEMPERATURES UP TO 1000°F
Joseph Viglione 18 Oct. 1963 34 p refs
(NAEC-AML-1760; AD-423245) OTS: $3.60

Temperatures were determined at which the beneficial effects of shot peening on the fatigue properties of chromium-plated high strength steel would be nullified. It was found that the beneficial effects were retained with exposure to heat up to 1000° F, with little or no decrease in fatigue properties. The fatigue limit of the unpeened plated steel increased with exposure to higher temperatures, until at 1000° F the fatigue limit value for the plated steel nearly approached those of the bare, the peened, and the plated-and-peened steel. Author

N65-15048# IIT Research Inst., Chicago, Ill. Technology Center
FIBER-REINFORCED METALS AND ALLOYS Bimonthly Report, Jul. 8–Sep. 8, 1964
N. M. Parikh 26 Oct. 1964 15 p
(Contract NOw-64-0066-c)
(IITRI-B6020-5; AD-450256)

Discussed is work done on the mechanisms of strengthening and deformation, and the fracture behavior of composites of tungsten–silver and steel–silver with both short alined fibers as well as long continuous fibers. The steel–silver composites were fabricated by hot extrusion below the recrystallization temperature of steel. The investigations indicated that with short discontinuous alined fibers in a composite, only a fraction of the fiber strength is realized. Ductile-to-brittle transitions were found in both steel–silver and tungsten–silver composites. Fracture energy measurements were used to clarify the ductile-to-brittle behavior in the analysis of fracture modes. P.V.E.

N65-15131# Battelle Memorial Inst., Columbus, Ohio.
EFFECT OF ELECTRON CONCENTRATION ON THE PROPERTIES OF ALLOYS OF REFRACTORY METALS Annual Topical Report
J. G. Booth 30 Oct. 1964 32 p refs
(Contract Nonr-3589-(00))
(AD-607799) OTS: $2.00

Magnetic susceptibilities in the range 0° to 600° C were measured to ascertain the effects of an alloying element on the electronic structure of Group VI-A metals. The evidence presented indicates the probability that the addition of rhenium to chromium, molybdenum, and tungsten results in an increase in $n(E_f)$. A summary of the current status of work on interstitial solubility shows that the electronic structure and the equilibrium solubility for interstitial elements are related, but the mechanisms of this relationship still remain obscure. An isopiestic method of determining the equilibrium solubility of nitrogen in chromium–rhenium alloys involves the production of a nitride phase on the surface of a specimen and its subsequent enclosure in an evacuated tube with a virgin sample of the same material. Preliminary X-ray spectrometric evidence indicates that the equilibrium surface nitride produced on a specimen of Cr-35Re at 1100° C is βCr_2N. Results obtained on the antiferromagnetic behavior of alloys of chromium with ruthenium, rhodium, osmium, and rhenium are given, and their implications are discussed. R.L.K.

N65-15136# Boeing Co., Renton, Wash. Airplane Div.
INVESTIGATION OF THE EFFECTS OF STRESS CORROSION ON HIGH-STRENGTH STEEL ALLOYS
Gary A. Dreyer and Wesley C. Gallaugher Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1964 129 p refs
(Contract AF 33(657)-8705)
(ML-TDR-64-3; AD-605672)

The stress corrosion susceptibility of several high strength steels has been evaluated by alternate-immersion laboratory testing in a 3.5% sodium chloride solution. The steels evaluated were the stainless steels AFC 77, AM 350, AM 355, and 17-4PH; the low alloy steels D6AC, 4335M, 4340, H-11, 4330 M, and HY-Tuf; and the high nickel steels 18Ni-9Co-5Mo, 18Ni-7Co-5Mo, and 9Ni-4Co. The variables investigated were product form, grain direction, tensile strength level, stress level, cold working, ausforming, welding, and protective coatings. Detailed results relating stress-corrosion susceptibility to the variables and alloys studied are included. Notch-tensile and fatigue-cracked fracture-toughness testing was carried out for

correlation with stress-corrosion susceptibility. Optical microscopy, electron microscopy, and X-ray diffraction studies were made to supplement the mechanical property and stress corrosion testing. A literature survey or related stress corrosion test data is included. Author

N65-15145*# Case Inst. of Tech., Cleveland, Ohio.
EFFECTS OF HYDROSTATIC PRESSURE CYCLING ON THE MECHANICAL BEHAVIOR OF BODY CENTERED CUBIC REFRACTORY METALS AND ALLOYS Interim Technical Report No. 1
Dec. 1964 16 p refs
(Grant NsG-654)
(NASA-CR-60177) OTS: HC $1.00/MF $0.50

The effects of hydrostatic pressures of 5, 10, and 20 kilobars in inducing permanent changes in substructure were investigated by transmission electron microscopy for a high-purity iron and two iron–carbon alloys (0.065 and 0.30 wt% carbon). The results show that after subjection to pressure, new dislocation arrays are found in the vicinity of many of the second-phase particles present in these materials. These observations provide direct support for the hypothesis that the previously reported changes in the plastic behavior of iron–carbon alloys as the result of the application of hydrostatic pressure are due to the generation of "free" dislocations. Analogous studies on tungsten have been initiated. Preliminary pressure cycling experiments on annealed thoriated tungsten wire to peak pressures of 14 and 20 kilobars were carried out. Author

N65-15189*# Ilikon Corp., Natick, Mass.
BASIC STUDIES ON DISPERSION HARDENING Final Report
Robert Grierson 10 Apr. 1964 50 p
(Contract NASw-726)
(NASA-CR-60225) OTS: HC $2.00/MF $0.50

An investigation of the elastic strains associated with the particle–matrix interface in certain dispersion strengthened alloys was carried out. Two techniques were used to observe these strains. These techniques involve the measurement of diffraction contrast effects as observed using transmission electron microscopy and the measurement of the broadening of X-ray diffraction lines. Author

N65-15203 Istituto Sperimentale dei Metalli Leggeri, Novara (Italy).
SUB-GRAIN SIZE IN 4, 7, 10 and 14% Al_2O_3 SAP EXTRUDED BARS THERMAL TREATED AT 600 AND 650°C [DIMENSIONI DEI SUB-GRANI IN ESTRUSI DI SAP 4, 7, 10 E 14% Al_2O_3, RICOTTI A 600 E A 650°C]
M. Paganelli Brussels, EURATOM, 1964 49 p refs In ITALIAN; ENGLISH summary Presented at the "Convegno sui Metalli non Fissili nei Reattori Nucleari", Bologna, 16–18 Dec. 1963
(Contract EURATOM-092-63-04 ORGI)
(EUR-1847.i) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 70 Belg. Fr.

A method of thinning bulk metal samples for transmission electron microscopy purposes was applied to Al_2O_3 SAP extruded bars, as extruded and after thermal treatment at 600° and 650° for 3 hours. The bars showed a subgrain structure, with the average linear size of subgrains about 1.1μ for the 4%, and about 0.45μ for the 14% Al_2O_3 SAP. Subgrain boundaries were generally affected by oxide particles, which pinned the dislocations inside the subgrains. In the thinned samples, these oxide particles were surrounded by a halo, which was not affected by heat. A thermal treatment at 600° and 650° caused a strong decrease of dislocation number inside and at the boundaries of subgrains, but did not increase the subgrain size. During extrusion or further thermal treatment, SAP did not undergo recrystallization. Author

N65-15210# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING OCTOBER, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Nov. 1964 58 p
(Contract W-7405-ENG-92)
(BMI-1697(Del.)) OTS: $1.25

Recent progress in the following study programs is summarized: *Reactor Materials and Components, Studies of Fuels, Radioisotope and Radiation Applications, Coated-Particle Fuel Materials, Corrosion Studies of the Fluoride-Volatility Process,* and *Gas-Cooled Reactor Program.* G.G.

N65-15265# Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW—A BIMONTHLY TECHNICAL PROGRESS REVIEW, VOLUME 2, NO. 4, AUGUST 1964
O. E. Dwyer, ed. Nov. 1964 70 p
(BNL-892(PR-10), V. 2, No. 4) OTS: $3.00

CONTENTS:

1. SNAP 50/SPUR POWER SYSTEM H. H. Dannan (AiResearch Mfg. Co., Phoenix, Ariz.) p 1–2
2. REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1964 R. M. Adams and A. Glassner (Argonne Natl. Lab.) p 2–4
3. REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JULY 1964 R. M. Adams and A. Glassner (Argonne Natl. Lab.) p 5–6
4. REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1964 R. M. Adams and A. Glassner (Argonne Natl. Lab.) p 7–9
5. STATUS SUMMARY OF APDA SMALL LEAK SODIUM-WATER REACTION TEST PROGRAM H. O. Muenchow (Atomic Power Develop. Associates) p 9–10
6. SODIUM HEATED STEAM GENERATOR DEVELOPMENT Paul Probert (Babcock & Wilcox Co.) p 10–11
7. HEAT TRANSFER IN COILED TUBES WITH TWO PHASE FLOW J. R. Carver et al (Babcock and Wilcox Co.) p 11–13
8. PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES R. E. Engdahl (Consolidated Controls Corp.) p 13–14
9. MASS TRANSFER INVESTIGATION IN LIQUID METAL SYSTEMS, MONTHLY PROGRESS LETTER NO. 60 R. W. Lockhart (Gen. Elec. Co., San Jose, Calif.) p 14–15
10. MASS TRANSFER INVESTIGATION IN LIQUID METAL SYSTEMS, MONTHLY PROGRESS LETTER NO. 61 R. W. Lockhart (Gen. Elec. Co., San Jose, Calif.) p 15–16
11. SODIUM COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM C. E. Breizy and F. J. Leitz (Gen. Elec. Co., San Jose, Calif.) p 16
12. ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS, QUARTERLY PROGRESS REPORT NO. 6 J. Longo, Jr. (Gen. Elec. Co., Cincinnati) p 17–18
13. ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS, QUARTERLY PROGRESS REPORT NO. 7 Frank E. Tippets (Gen. Elec. Co., Cincinnati) p 19–20
14. TWO-STAGE POTASSIUM TEST TURBINE E. Schnetzer (Gen. Elec. Co., Cincinnati) p 20–21

15. ELECTROMAGNETIC ALKALI-METAL PUMP RESEARCH PROGRAM J. P. Verkamp (Gen. Elec. Co., Cincinnati) p 21–22

16. HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS H. F. Poppendiek et al (Geoscience) p 22–23

17. NATURAL CONVECTION HEAT TRANSFER COEFFICIENTS FOR LIQUID METALS AT HIGH HEAT FLUXES Akbar F. Brinsmade and Leland G. Desmon (Hercules Powder Co., Cumberland, Md.) p 23–24

18. CAVITATION DAMAGE IN LIQUID SODIUM H. Preiser, A. Thiruvengadam, and C. Couchman (Hydronautics) p 24–26

19. COMMENTS ON "IN-HOUSE LIQUID METALS INVESTIGATION" Ruth N. Weltmann (NASA. Lewis Res. Center) p 26–34

20. LOS ALAMOS SCIENTIFIC LABORATORY QUARTERLY STATUS REPORT ON PLUTONIUM REACTOR FUEL DEVELOPMENT p 34

21. THE EFFECT OF SURFACE CONDITIONS ON POOL BOILING HEAT TRANSFER OF SODIUM Paul Marto (MIT) p 35

22. EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS, PROGRESS REPORT 45 R. C. Andrews and K. R. Barker (MSA Res. Corp.) p 35–36

23. EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS, PROGRESS REPORT 46 R. C. Andrews and K. R. Barker (MSA Res. Corp.) p 37–38

24. EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS, PROGRESS REPORT 47 R. C. Andrews and K. R. Barker (MSA Res. Corp.) p 38

25. EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS, TOPICAL REPORT NO. 3 R. C. Andrews and K. R. Barker (MSA Res. Corp.) p 39–40

26. HIGH TEMPERATURE PROPERTIES OF SODIUM AND POTASSIUM C. T. Ewing et al (Naval Res. Lab., Washington, D.C.) p 40–41

27. HIGH TEMPERATURE PROPERTIES OF SODIUM, POTASSIUM, AND CESIUM J. P. Stone et al (Naval Res. Lab., Washington, D.C.) p 41–43

28. RESEARCH IN THE FIELD OF LIQUID-METAL-LUBRICATED BEARINGS V. R. Degner (Rocketdyne, Canoga Park, Calif.) p 43–44

29. FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS R. A. Burton and H. J. Carper (Southwest Res. Inst.) p 45–46

30. ACOUSTIC NOISE FROM A CAVITATING VENTURI R. Garcia, F. G. Hammitt, and M. J. Robinson (Mich. U.) p 46–47

31. REVIEW OF LIQUID METAL HEAT TRANSFER AND PRESSURE DROP L. E. Efferding and A. A. Bishop (Westinghouse Elec. Corp., Pittsburgh) p 47–48

32. SODIUM COLD TRAP STUDIES J. Herb (Westinghouse Elec. Corp., Pittsburgh) p 48–50

N65-15299# Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center

EVALUATION OF ELECTROWON TUNGSTEN POWDER

G. H. Keith, B. D. Jones, and E. A. Rowe 1965 17 p refs (BM-RI-6578)

An evaluation of electrowon tungsten powder was made by comparing its characteristics with conventional hydrogen-reduced tungsten powder. Electrowon tungsten powder was investigated with respect to particle size and shape, apparent density, flow rate, compressibility, green strength, and sintering characteristics. In addition, its chemical purity, absolute density, and purification by melting were determined. Significant findings were higher flow rates and better compressibility than hydrogen-reduced tungsten powder. However, the large particle size peculiar to the electrowinning process effectively prevented conventional sintering to a high-density material. The possibility of producing high-density material, using a new technique of hot swaging sheathed sintered-tungsten compacts, was demonstrated by the achievement of densities of 92% of theoretical. Author

N65-15303# Pratt and Whitney Aircraft, Middletown, Conn.

LOW PRESSURE OXIDATION OF COLUMBIUM-1 ZIRCONIUM

Robert W. Harrison and Eugene J. Delgrosso 30 Apr. 1964 21 p refs

(Contract AT(30-1)-2789)

(CNLM-5351)

The reactions of Cb-1 Zr alloy with oxygen were investigated at various temperatures and pressures. Continuous weight-gain measurements were made using a vacuum thermobalance capable of detecting a 0.15 ±0.05 mg weight change at temperatures up to 3500°F from atmospheric pressure to 1400°, and 1600°F from 1×10^{-3} to 1×10^{-5} mm Hg for 10-hour test periods. Corresponding quantitative internal oxidation test periods. Corresponding quantitative internal oxidation measurements were performed to correlate hardness, penetration depth and oxygen content. The following reactions occurred sequentially: adsorption and solution of oxygen creating a dispersed ZrO_2 subscale by internal oxidation, formation of orientation dependent CbO, oxidation of CbO to CbO_2, and subsequent establishment of a continuous CbO_2 layer. This CbO_2 layer caused protective oxidation and directly affected the total weight gain and degree of oxygen penetration. The CbO indirectly influenced protective oxidation behavior, since the quality of the CbO_2 scale apparently was related to the amount of CbO initiating CbO_2. Oxidation parameters are indicated for protective and nonprotective scale formation, and corresponding internal oxidation. Author

N65-15305 Rensselaer Polytechnic Inst., Troy, N.Y.

THE MATERIAL TRANSPORT MECHANISM DURING SINTERING OF COPPER POWDER COMPACTS AT HIGH TEMPERATURES

J. G. Early, F. V. Lenel, and G. S. Ansell [1963] 27 p refs

The isothermal shrinkage rates of copper powder compacts were determined in the temperature range from 760° to 1060° C. The rates for compacts from a pure spherical copper powder were compared, on the one hand, with those from a spherical powder with a dispersion of aluminum oxide in the copper matrix and, on the other hand, with those from a pure copper powder having irregularly shaped particles. The irregular copper powder compacts shrank much faster than the spherical copper powder compacts and these, in turn, shrank faster than dispersion-strengthened copper powder compacts. The experiments were run under a small external load. By varying this load, the stress dependence of the isothermal shrinkage rate could be measured for compacts from spherical copper powders. It is concluded that the material transport mechanism is due to dislocation climb rather than to Herring–Nabarro creep. Author

N65-15324# Columbia U., New York, N.Y. Inst. for the Study of Fatigue and Reliability

MECHANISM OF FATIGUE DEFORMATION AT ELEVATED TEMPERATURES

M. Ronay, W. H. Reimann, and W. A. Wood Jun. 1964 32 p refs
(Contract Nonr-266(91))
(TR-07; AD-607225) OTS: $2.00

The basic mechanism of fatigue is studied in annealed alpha-brass subjected to alternating torsion at room temperature, 100°, 200°, 300°, and 400° C, and in air. The slip-zone microcracking which characterizes fatigue damage produced by small amplitudes at room temperature is progressively replaced by grain-boundary cracking at elevated temperatures, replacement being complete at 400° C. Replacement occurs not because slip activity decreases but because slip movements at elevated temperatures cease to concentrate in narrow zones and instead disperse. Decrease of amplitude at 400° C, though permitting longer lives of specimens before fracture, actually causes increase in grain-boundary damage, an anomaly attributed to the greater difficulty at elevated temperature of starting and propagating a crack. Surface corrosion was most pronounced along slip bands. Author

N65-15413# Purdue U., Lafayette, Ind.
THE VARIATION IN THE STRUCTURE OF PREPRECIPITATION ZONES DURING AGING
Darrell Russell James (M.S. Thesis) Jan. 1964 94 p refs
Sponsored by ARPA
(AD-423004)

The diffuse X-ray intensity due to the zones in an Al-3.85 wt% Cu alloy aged at 130° C was obtained by a counter diffractometer method, and the Fourier transform of the amplitude was taken near the (200)Al reciprocal lattice point. The observed electron density, along with a truncation function expressing the limits of the measurement, was used to find the actual electron density by a relaxation method. The average G.P. 1 zone consisted of 3 to 5 copper enriched planes which changed in atomic percent copper content from 2.81:56.6:2.81 to 2.17:29.9:2.17 upon aging from 6 to 36 hours at 130° C. The layer displacements of the first and second planes from the zone center were determined to be 22.5×10^{-3} Å and 12.5×10^{-3} Å respectively. The displacement then decreased to 7.5×10^{-3} Å at the eighth layer. The c parameter of G.P. 2 was observed to change from 7.90 to 7.63 ±0.01 Å between 72 and 303 hours aging at 130° C, and the c parameter of the tetragonal θ′ structure was found to be 5.84 ±0.01 Å. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-14583# Debell and Richardson, Inc., Hazardville, Conn.
GLASS/RESIN INTERFACE: PATENT SURVEY, PATENT LIST, AND GENERAL BIBLIOGRAPHY
William J. Eakins Dover, N.J., Picatinny Arsenal, Sep. 1964 53 p refs
(PLASTEC-18) OTS: $1.25

Presented is a patent survey within three areas pertaining to the glass–resin interface problem, as encountered in the fabrication of glass-reinforced plastics. The areas covered are: the sizing of glass fibers, the cleaning of glass strand and fabric, and the use of glass–resin coupling agents. Included is a list of 77 patents and a general bibliography of 146 items on glass–resin interface. Author

N65-14666# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
FUSED SILICA MANUAL Final Report, Nov. 14, 1958–Jul. 1, 1964
J. D. Fleming 1 Sep. 1964 191 p refs
(Contract AT(40-1)-2483)

The structure of fused silica, and its fabrication, physical, thermophysical, and thermochemical properties, irradiation behavior, chemical resistance, and application are presented. The chemical inertness and resistance to thermal shock of fused silica make it ideally suited to construction of laboratory apparatus and premium glassware. Unique transmission characteristics and a very low coefficient of thermal expansion ideally qualify fused silica for critical lens, lightguide, window, and mirror applications. The high specific resistance and dielectric strength of fused silica promote its use as insulation in many types of critical equipment. Since fused silica is refractory, and has good high-temperature strength, corrosion resistance, and resistance to thermal shock, it should be applicable as a refractory structural material. The optical clarity, strength, thermal shock resistance and radiation damage resistance combine to suit fused silica as a structural unit functioning as an optical component. R.W.H.

N65-15016*# North Carolina State Coll., Raleigh.
INVESTIGATIONS OF THE PERMEABILITY OF PARACHUTE FABRICS Semiannual Progress Report
Fredrick O. Smetana Nov. 1964 5 p
(Grant NsG-686)
(NASA-CR-60137) OTS: HC $1.00/MF $0.50

In determining the permeability of parachute fabrics under simulated high altitudes, it is assumed that: (1) air pressure behind the descending canopy is the same as the free stream pressure at that altitude; (2) pressure on the windward side is the stagnation pressure behind a normal shock if the descent is supersonic, or free stream stagnation pressure if it is a subsonic descent; and (3) pressures are uniform over the parachute canopy. An apparatus has been constructed using these concepts, and installation of a new pumping system, with a capacity 6 to 50 times greater than that used in previous tests, makes it possible to obtain pressures one-half to one-sixth as large. A 4-in. sample replaces the 1.75-in. size, as a compromise between large pressure drops and uniform velocity profiles. Instrumentation has also been revised to permit faster and more accurate data acquisition and reduction. M.G.J.

N65-15266# IIT Research Inst., Chicago, Ill.
MICA STRUCTURE PROPERTIES: DEHYDRATION, SWELLING AND ANISOTROPIC THERMAL EXPANSION OF PHLOGOPITE MICAS STUDIED BY TRANSMISSION ELECTRON MICROSCOPY
L. Cartz and B. Tooper 20 Oct. 1964 49 p refs

Phlogopite micas were examined by transmission electron microscopy and showed evolution of gas bubbles at room temperature and also on heating to a range of 300° to 600° C in the electron microscope. The gas bubbles occur particularly on dislocation networks, and at nodal points larger gas bubbles tend to accumulate. The gas bubbles are small lenticular flaws arising from the separation of (0001) cleavage planes. The bubbles grow in size with increase of temperature, and the whole dislocation network converts at ~700° C into a large lenticular flaw. The gas evolved at higher temperatures is

water from the dehydration of the mica; at lower temperatures some of the gas evolved is from the solvent used in the preparation of specimens. Double diffraction patterns are frequently observed. The swelling and anomalous thermal expansion behavior of micas, as well as the formation of packing faults, are discussed. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-14513 Lockheed Missiles and Space Co., Sunnyvale, Calif.

CONTRIBUTIONS TO THE QUALITATIVE THEORY OF DIFFERENTIAL EQUATIONS (TOPOLOGICAL DYNAMICS), VOLUME I

T. R. Jenkins, W. E. Johnson, and C. M. Petty [1964] 96 p refs (LMSC-TR-6-74-64-44)

CONTENTS:

1. MINIMAL CENTER OF ATTRACTION W. E. Johnson p 7–14 (See N65-14514 05-19)
2. RECURRENT MOTIONS T. R. Jenkins and W. E. Johnson p 15–18 (See N65-14515 05-19)
3. CENTRAL MOTIONS OF DYNAMICAL SYSTEMS T. R. Jenkins and W. E. Johnson p 18–25 (See N65-14516 05-19)
4. REMARKS ON THE PROOF OF BIRKHOFF'S ERGODIC THEOREM T. R. Jenkins, W. E. Johnson, and C. M. Petty p 26–41 (See N65-14517 05-19)
5. TOPOLOGICAL DYNAMICS IN C(X), PRELIMINARY REPORT T. R. Jenkins and W. E. Johnson p 42–60 (See N65-14518 05-19)
6. DIFFERENTIAL EQUATIONS—EXAMPLES W. E. Johnson p 61–67 (See N65-14519 05-19)
7. EXISTENCE OF HALF-TRAJECTORIES IN PRESCRIBED REGIONS AND ASYMPTOTIC ORBITAL STABILITY W. E. Johnson p 68–75 (See N65-14520 05-19)
8. PARALLELIZABILITY OF DYNAMICAL SYSTEMS T. R. Jenkins and W. E. Johnson p 76–79 (See N65-14521 05-19)
9. DISCONJUGATE SOLUTIONS OF SECOND ORDER LINEAR EQUATIONS C. M. Petty p 80–89 (See N65-14522 05-19)

N65-14514 Lockheed Missiles and Space Co., Sunnyvale, Calif.

MINIMAL CENTER OF ATTRACTION

W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 7–14 (See N65-14513 05-19)

Alternative proofs of theorems 6.06 and 6.12 of Nemytskii and Stepanov (*Qualitative Theory of Differential Equations*, Princeton Press, 1960) are presented. Beginning with a generalization of the set (6.09 in the above reference) and its definition for a given invariant set E, it is directly shown that it is the unique minimal center of attraction for E in the Lagrange stable case. Also, some of the properties of this set in the case where the motions in E are not required to be Lagrange stable are noted. M.P.G.

N65-14515 Lockheed Missiles and Space Co., Sunnyvale, Calif.

RECURRENT MOTIONS

T. R. Jenkins and W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 15–18 (See N65-14513 05-19)

Theorem 7.09 of Nemytskii and Stepanov (*Qualitative Theory of Differential Equations*, Princeton Press, 1960) gives a necessary and sufficient condition for a Lagrange stable motion to be recurrent. In this paper, a necessary and sufficient condition is given for a motion to be recurrent without requiring that it be Lagrange stable. M.P.G.

N65-14516 Lockheed Missiles and Space Co., Sunnyvale, Calif.

CENTRAL MOTIONS OF DYNAMICAL SYSTEMS

T. R. Jenkins and W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 18–25 (See N65-14513 05-19)

Mathematical analyses concerning the set of central motions in the Birkhoff definition of a compact, dynamical system are given. It is shown that the center so defined is the largest, closed, regionally recurrent set in the space of a dynamical system that is invariant under the flow. Two results concerning the closure, unions, and intersections of families of regionally recurrent sets and invariant sets are also proved. M.P.G.

N65-14517 Lockheed Missiles and Space Co., Sunnyvale, Calif.

REMARKS ON THE PROOF OF BIRKHOFF'S ERGODIC THEOREM

T. R. Jenkins, W. E. Johnson, and C. M. Petty *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 26–41 (See N65-14513 05-19)

Supplements and corrections to the proofs of the Birkhoff ergodic theorems given by Nemytskii and Stepanov (*Qualitative Theory of Differential Equations*, Princeton Press, 1960) are given. M.P.G.

N65-14518 Lockheed Missiles and Space Co., Sunnyvale, Calif.

TOPOLOGICAL DYNAMICS IN C(X), PRELIMINARY REPORT

T. R. Jenkins and W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 42–60 (See N65-14513 05-19)

A theorem is given that establishes that the dynamical system τ on $X \times I$ to X induces a dynamical system on $C(X) \times I$ to $C(X)$ when $C(X)$ is suitably topologized. A restricted case in the Bebutov system (one of the simple systems in the above described class) is considered: If X is suitably restricted, then the points of X and the maximal ideals of $C(X)$ are intimately related. Information concerning the flow τ on X is obtained from knowledge of the behavior of the family ϕ_τ on ideals of $C(X)$. M.P.G.

N65-14519 Lockheed Missiles and Space Co., Sunnyvale Calif.

DIFFERENTIAL EQUATIONS—EXAMPLES

W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 61–67 (See N65-14513 05-19)

The equation of motion of a simple pendulum is used to construct a linear equation which approximates the equation for simple harmonic motion but which has an unbounded solution. Proof of the unbound condition of the solution is obtained as a special case of a more general lemma regarding a one-parameter family of periodic functions with periods dependent on the parameter. In a separate study, the limit cycles of dynamical systems are considered. M.P.G.

N65-14520 Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXISTENCE OF HALF-TRAJECTORIES IN PRESCRIBED REGIONS AND ASYMPTOTIC ORBITAL STABILITY
W. E. Johnson *In its* Contrib. to The Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 68–75 Submitted for Publication (See N65-14513 05-19)

A theorem is proved on the existence of a half trajectory in the neighborhood of a semi-invariant set of a general dynamical system, and from it three corollaries are deduced. Corollary 2 is a generalization of Mendelson's theorem. Corollary 3 gives a sufficient condition for a neighborhood of a rest point to contain a half trajectory which is not a rest point, and it is shown by example that, in a sense, the condition is the best possible. The theorem is used to obtain a necessary and sufficient condition for a compact, positively invariant set to be positively asymptotically orbitally stable. This condition is compared with one due to Lefschetz. Author

N65-14521 Lockheed Missiles and Space Co., Sunnyvale, Calif.
PARALLELIZABILITY OF DYNAMICAL SYSTEMS
T. R. Jenkins and W. E. Johnson *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 76–79 Submitted for Publication (See N65-14513 05-19)

A dynamical system f on a metric space R with distance function ρ is considered. Nemytskii and Stepanov (*Qualitative Theory of Diffential Equations*, Princeton Press, 1960) in lemma 10.06 have shown that if a dynamical system is unstable and has no improper saddle point, then the following condition obtains: given p, $p_n \in R$, and $t_n \in I$, $n = 1,2,\ldots$, such that $p_n \to p$ and $|t_n| \to \infty$, the sequence $[f(p_n, t_n)]$ has no limit point. This note points out that, conversely, if the above condition holds, then the system is unstable and has no improper saddle point. Thus, for a locally compact separable space, this condition is still another necessary and sufficient condition for "parallelizability." M.P.G.

N65-14522 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DISCONJUGATE SOLUTIONS OF SECOND ORDER LINEAR EQUATIONS
C. M. Petty *In its* Contrib. to the Qualitative Theory of Differential Equations (Topological Dyn.) [1964] p 80–89 (See N65-14513 05-19)

Three theorems for Jacobi's equation are proved, giving the conditions obtaining for the solution to be disconjugate on I. M.P.G.

N65-14523# Mitre Corp., Bedford, Mass.
THE MINIMUM NUMBER OF LINEAR DECISION FUNCTIONS TO IMPLEMENT A DECISION PROCESS
H. Joksch and D. Liss Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 14 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-171; TM-03903; AD-609476)

This document determines a lower limit on the number of linear decision functions necessary to place a certain number of objects into a certain number of categories. This lower limit is a function of the number of parameters necessary to describe each object and the number of categories. Author

N65-14547# Dartmouth Coll., Hanover, N.H. Thayer School of Engineering
REFINEMENT OF THE PULSE TESTING PROCEDURE COMPUTER LIMITATIONS
Sidney Lees and Ray C. Dougherty Oct. 1964 84 p refs
(Contract Nonr-3897(03))
(AD-608524)

A basic limitation to the calculation of Fourier transforms and system functions was investigated. It is demonstrated that much of the past difficulty must reside in the inadequacy of the approximation when an insufficient number of data points is employed. There is reason to believe that the number of points should be about 10 times as great as has been customary, e.g., where 100 and 200 points were considered adequate, now at least 1000 points should be used. Expressions have been obtained for the error in using approximate forms for exact integrals for the Fourier transform. It is possible in any specific instance to calculate the error and to make good estimates of how well the approximation fits the exact solution. It is also possible to determine whether a particular expression can be tested against experimentally derived data. Author

N65-14629*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
QUADRATURE FORMULAS FOR THE Λ AND Φ OPERATORS OF RADIATIVE TRANSFER
Mark Cane Washington, NASA, Jan. 1965 72 p refs
(NASA-TN-D-2588) OTS: HC $3.00/MF $0.75

Gaussian quadrature abscissas and weight for the Λ and Φ operators of radiative transfer were numerically evaluated to an accuracy of eight significant figures. The results are presented for $\tau = 0$ (orders 2 through 10) and for $\tau = .001(.001).009, .010(.005).095, 0.1(.05)0.95, 1.0(0.1)2.9, 3.0(0.2)4.8, 5.0(1.0)10.0, 15, 20$ (orders 2 through 5). Author

N65-14633# Stanford U., Calif.
DEFORMATION OF STRUCTURES ON MANIFOLDS DEFINED BY TRANSITIVE, CONTINUOUS PSEUDOGROUPS. PART III: STRUCTURES DEFINED BY ELLIPTIC PSEUDOGROUPS Technical Report No. 1
D. C. Spencer 15 Oct. 1964 110 p refs
(Contract DA-31-124-ARO(D)-151-2)
(AROD-4323-1; AD-450815)

In another paper a theory was developed for deformation of structures on manifolds defined by arbitrary, transitive, continuous pseudogroups which, in the case of structures on compact manifolds defined by complex, transitive, continuous pseudogroups, incorporates the fundamental mechanism of the general theory, including the existence of local deformations, i.e., the existence of local coordinates for the deformed structure. The purpose of this report is to outline a procedure for extending the fundamental mechanism, and the main theorems, to elliptic pseudogroups. An elliptic pseudogroup is a transitive, continuous pseudogroup of local bidifferentiable transformation whose Lie pseudoalgebra of infinitesimal transformations is defined by an elliptic system of linear partial differential equations. Author

N65-14685# RAND Corp., Santa Monica, Calif.
IDENTIFICATION OF DIFFERENTIAL SYSTEMS WITH TIME-VARYING COEFFICIENTS
Richard Bellman, Brian Gluss, and Robert Roth Nov. 1964 19 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4288-PR; AD-607755) OTS: $1.00

The problem of obtaining an optimal fit to observed data is considered by determining successive approximating systems of linear differential equations with time-varying coefficients. This latter characteristic introduces little additional complexity in applying the differential approximation and quasi-linearization methods used in the time-invariant case. Two examples are considered in order to demonstrate the method. Author

N65-14754# Air Force Systems Command, Kirtland AFB, N. Mex. AF Weapons Lab.
SAMPLING FOR RELIABILITY DETERMINATION — AN IMPROVED SCHEME Technical Report, May–Sep. 1964
W.C. Beckham Oct. 1964 55 p refs
(WL-TR-64-116; AD-607909)

A unique solution is presented for the ancient sampling problem posed as follows: A finite random sample from a large population is to be tested for some property that an unknown fraction of the population possesses. It is required to deduce the most accurate possible probabilistic statements in the following sense. For a specified probability that the unknown fraction be larger than some lower limit, calculate from the test result the largest possible lower limit that will have at least this probability and the smallest possible upper limit that will have at most this probability. Similarly, specify narrowest possible ranges for upper limits. These formulas can then be applied to determine for specified lower and upper limits two probabilities for their enclosure of the unknown fraction, the larger of which is the lowest possible upper limit and the smaller of which is the largest possible lower limit. Author

N65-14758 Wisconsin U., Madison.
THE EXPERIMENTAL STUDY OF PHYSICAL MECHANISMS
G. E. P. Box and William G. Hunter Apr. 1964 21 p refs
(Grant NSF GP-2755)
(AD-604265)

The search for underlying physical mechanisms constitutes a major portion of effort in many scientific and engineering fields. The objective of the experimenter is to obtain an estimate of the response η over some particular region of interest in the space variables and to determine the underlying physical mechanism of the phenomenon under investigation. Such investigations consist logically of two steps: (1) establishing the form of an adequate model, and (2) estimating precisely the values of its parameters. Fisher referred to these as the problems of specification and estimation. A close class of sequential designs could exist which would permit an attack on both problems from the outset of the investigation. R.W.H.

N65-14786# Research Triangle Inst., Durham, N.C.
A NOTE ON CURVE-CROSSINGS BY NORMAL PROCESSES Technical Report No. 2
M. R. Leadbetter Oct. 1964 7 p refs
(Contract Nonr-4565(00))
(SU-181; AD-607706) OTS: $1.00

In a previous report the mean number of zeros (roots) of a separable normal nonstationary process [x(t)], in a given time T, was calculated under the following assumptions: (1) The mean $m(t) = \epsilon\{x(t)\}$ possesses a continuous derivative $m'(t)$ in the range $0 \le t \le T$. (2) The covariance function $\Gamma(t,t') = \mathrm{cov}\{x(t), x(t')\}$ possesses a continuous mixed second partial derivative

$$\frac{\delta^2\Gamma}{\delta t \delta t'}, \quad 0 \le t,t' \le T.$$

(3) The process x(t) has a continuous sample derivative x' (t) in the range $0 \le t \le T$. In the present paper it is shown that conditions (2) and (3) can be omitted in the calculation if only genuine crossings of the axis are considered (i.e., tangencies to the axis are not considered). P.V.E.

N65-14798# Wisconsin U., Madison. Mathematics Research Center
NUMERICAL CONTOUR INTEGRATION
Robert Ellis Barnhill (Ph.D. Thesis) Oct. 1964 85 p refs
(Contract DA-11-022-ORD-2059)
(MRC-519; AD-608854)

An error functional related to quadratures on contours in the complex plane is minimized, subject to certain side conditions, and computed examples are given. The convergence of complex quadratures is discussed, and theorems characterizing the domains of holomorphy that ensure convergence are given. Author

N65-14799# Wisconsin U., Madison. Mathematics Research Center
ON THE DEGREE OF APPROXIMATION OF CONTINUOUS FUNCTIONS BY POSITIVE LINEAR OPERATORS
J. Karamata and M. Vuilleumier Oct. 1964 13 p refs
(Contract DA-11-022-ORD-2059)
(MRC-521; AD-608851)

A previous theorem on the essential role of positive linear operators in the theory of approximation of continuous functions has been extended to general linear positive operators. M.G.J.

N65-14800# Wisconsin U., Madison. Mathematics Research Center
OUTGOING SOLUTIONS OF THE WAVE EQUATION WITH POTENTIAL
D. Thoe Nov. 1964 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-525; AD-608853)

A solution u of the wave equation

$$u_{tt}(x,t) - \Delta u(x,t) + q(x)u(x,t) = 0 (x \epsilon E^3, -\infty < t < \infty)$$

with finite energy is called outgoing if u vanishes in some forward light cone. The existence of outgoing solutions is proved for a class of potentials q which vanish sufficiently fast at ∞. Furthermore, the set of Cauchy data of outgoing solutions is shown to be dense in the sense of the energy norm in the set of Cauchy data of all solutions having finite energy. The proof depends upon the time-dependent scattering theory for the wave equation and the relation of this theory to the quantum mechanical scattering theory. Author

N65-14843# Naval Postgraduate School, Monterey, Calif.
TABLE OF THE DEBYE FUNCTIONS
Don E. Harrison, Jr. and John R. Neighbours Dec. 1964 77 p ref
(RR-49; AD-609702)

A seven-place table of the Debye integral and the ratio $C_v/3R$ was calculated. For $Z = \theta/T$ in the range $1.0 < Z < 30.0$ the increment in Z is 0.01 and for the range $30.0 < Z < 100$ the increment in Z is 0.1. The three-point Simpson's rule integrations were performed on a CDC 1604 computer. Author

N65-14860# RAND Corp., Santa Monica, Calif.
ABSTRACTION AND PATTERN CLASSIFICATION
R. Bellman, R. Kalaba, and L. A. Zadeh Oct. 1964 18 p refs
(Contract AF 49(638)-700)
(RM-4307-PR; AD-607500)

This is a preliminary paper which discusses a general framework for the treatment of pattern recognition problems. The notion of a "fuzzy" set is made precise. Then it is shown how this may be employed in a sequential experimental procedure to ascertain whether a symbol is a member of a particular set or not. The close relation between the problem of pattern recognition and interpolation is stressed. Author

N65-14908 Joint Publications Research Service, Washington, D.C.
THE MOST ADVANTAGEOUS BASE IN RECKONING SYSTEMS WITH REDUNDANT DIGITS REPRESENTATION
N. N. Posnov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 119–122 refs (See N65-14894 05-14) OTS: $6.00

Formulas are given to determine the number of place values necessary for representation of the possible digits in reckoning systems with redundant digits representation. It is shown that in the reckoning system with redundant digits representation and in the modernized system with a redundant digits representation the most advantageous base is found to be equal to ten. Author

N65-14939# RAND Corp., Santa Monica, Calif.
THE CONVEX HULL OF A RANDOM SET OF POINTS
Bradley Efron Oct. 1964 33 p refs
(Contract AF 49(638)-700)
(RM-4313-PR; AD-607796) OTS: $2.00

Various expectations concerning the convex hull of N independently and identically distributed random points in the plane or in space are evaluated. Integral expressions are given for the expected area, expected perimeter, expected probability content, and expected number of sides. These integrals are shown to be particularly simple when the underlying distribution is normal or uniform over a disk or sphere. Author

N65-14962# European Atomic Energy Community, Brussels (Belgium).
MINIMUM NUMBER OF INVERTERS IN AN ANALOGUE NETWORK [NOMBRE MINIMUM D'INVERSEURS DANS UN SCHEMA ANALOGIQUE]
P. Camion Oct. 1964 42 p refs In FRENCH; ENGLISH summary
(EUR-1918.f)

The problem treated is to find the nonzero elements in a matrix with elements 1, −1, 0, whose signs have to be changed so as to minimize the number of columns with elements of opposite signs. The procedure has to obey the rule that if the sign of an element in a line is changed, the signs of all elements in this line are changed. Also, a property of totally unimodular matrices and properties of cycles and cocycles of graphs to which they are connected are given. Author

N65-14975# Minnesota U., Minneapolis.
GENERALIZED INVERSES AND GENERALIZED GREEN'S FUNCTIONS
W. S. Loud Jul. 1964 39 p
(Grant DA-ARO(D)-31-124-G231)
(AROD-1465-9; AD-454713)

The following topics are considered: (1) For the case that A is a square matrix, A^+ is characterized in three different ways. (2) The form of A^+ under the transformation of A to Jordan canonical form is studied. (3) The case of the differential operator L is treated where the domain of L is the absolutely continuous functions on $0 \leq t \leq T$ whose derivatives are in $L^2(0,T)$, such that $x(T) = x(0)$, and for such an x, $Lx = x' - A(t)x$. Author

N65-15216# Joint Publications Research Service, Washington, D.C.
PROBLEMS OF OPTIMAL CONTROL
A. P. Liyepa 22 Jan. 1965 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 5, 1964
(JPRS-28418; TT-65-30182) OTS: $1.00

Two problems of optimal control are discussed: (1) a generalization of optimal regulation formulated in work, which establishes the necessary condition for optimality; three theorems are used to generalize the maximum principle; and (2) a problem of optimal regulation with fixed time and nonstationary end points, which establishes the conditions necessary for optimality of control, the minimization of the norm, and the problem with nonstationary ends. R.E.S.

N65-15273# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
RUNGE-KUTTA TYPE PROCEDURES OF ORDER OF ACCURACY $n + 4$ ($N > 2$) WITH THREE NODES FOR NUMERICAL INTEGRATION OF FIRST-ORDER DIFFERENTIAL EQUATIONS
A. Cotiu Dec. 1964 15 p refs Transl. into ENGLISH from Bulitinul Stiintifical Institutului Politehnic Din Cluj (Rumania), v. 5, 1962 p 39–49
(RSIC-341; AD-609692)

The Fehlberg transformation, which reduces the integration of a given differential equation to the integration of another first-order differential equation, is further extended. The extension allows the establishment of Runge–Kutta procedures of eighth-order accuracy with three nodes for numerical integration of the transformed differential equation. By analogy with a transformation given by Fehlberg for second-order differential equations, the transformation above is generalized. The general transformation determined in this way permits establishment of Runge–Kutta procedures of the order of accuracy, $n + 4$ ($n \geq 2$), with three nodes for numerical integration of the transformed differential equation. D.E.W.

N65-15274# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THEORY OF ERROR OF THE RUNGE-KUTTA METHOD
A. A. Kurmit Dec. 1964 22 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ. (Leningrad), no. 19, 1963 p 35-48
(RSIC-343; AD-609656)

The total error of the Runge–Kutta method is represented by the function $\epsilon(t)$, which is a solution to the problem

$$\epsilon' = \gamma(t)\epsilon + \tau(t), \quad \epsilon(t_0) = \epsilon_0, \quad ' = d/dt.$$

The material is presented in such a way that most of the results can be applied to any numerical method simply by using the approximate value of the solution at the preceding point. The problem is formulated, and the approximating function is constructed by the statement and proof of several theorems. D.E.W.

N65-15347# New York U., N.Y. Courant Inst. of Mathematical Sciences
THE ANOMALOUS CONCEPT OF STATISTICAL EVIDENCE: AXIOMS, INTERPRETATIONS, AND ELEMENTARY EXPOSITION
Allan Birnbaum Oct. 1964 51 p refs Presented at the Joint European Conf. of Statist. Soc., Berne, 14 Sep. 1964
(Contract Nonr-285(38))
(IMM-NYU-332; AD-607348) OTS: $2.00

This paper presents some new mathematical and interpretive material on concepts of statistical evidence. The material has been given a self-contained elementary expository form (restricted to the case of discrete probability distributions) suitable for early inclusion in any mathematical statistics course however elementary. A brief elementary account of the concept of statistical evidence and the anomalous problem of its interpretation is given. Further axioms are presented for evidence and derivations of their interrelations in elementary form. Concepts are presented which have figured significantly in the development of statistical thinking. The axioms of statistical evidence and some related concepts discussed, with their mathematical interrelations, are summarized schematically. The conceptual issues and historical patterns discussed are indicated schematically. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-14494# Aracon Geophysics Co., Concord, Mass.
PRACTICAL INTERPRETATION OF METEOROLOGICAL SATELLITE DATA Final Report
William K. Widger, Jr., Paul E. Sherr, and C. W. C. Rogers Sep. 1964 415 p refs *Its* Rept.-9219-12
(Contract AF 19(628)-2471)
(AFCRL-64-807; AD-609493)

The report is written specifically for the use of air weather service field forecasters. Topics considered include the coverage, scale, and resolution of the satellite data, operationally available data formats, coordination with other meteorological data, cloud type interpretation, key features observed in the pictures, extratropical vortex interpretations, other synoptic and mesoscale features, interpretations of tropical data, and contributions of the satellite data to weather forecasting. Procedures for the integration of satellite and conventional data and analyses, and for the use of satellite data to provide improved synoptic analyses, are developed and presented. Guidance for the operational interpretation, application, and value of infrared data for atmospheric windows is provided. Author

N65-14501# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Oct. 1964 60 p refs
(AD-608549) OTS: $1.25

CONTENTS:

ARTICLES
1. ATMOSPHERIC AEROSOLS NEAR THE SURTSEY VOLCANO C. M. Gordon, E. C. Jones, and J. I. Hoover p 1–3 refs (See N65-14502 05-20)
2. THE FABRY-PEROT REFRACTOMETER AND THE PRECISION NRL LYMAN-ALPHA HUMIDIOMETER D. L. Randall, D. Stilwell, and O. K. Larison p 4–12 refs (See N65-14503 05-14)

SCIENTIFIC PROGRAM—PROBLEM NOTES
3. ATMOSPHERE AND ASTROPHYSICS B. S. Yaplee et al p 13–15
4. CHEMISTRY H. R. Baker et al p 15–22
5. MECHANICS I. Vigness et al p 22–28
6. METALLURGY AND CERAMICS T. G. Digges, Jr. et al p 28–45 refs
7. NUCLEAR AND ATOMIC PHYSICS A. W. Saenz p 45–46 refs
8. RADIO W. D. Long et al p 46–53 refs
9. SOLID-STATE PHYSICS L. S. Birks et al p 53–54
10. SOUND R. L. Steinberger p 55

N65-14502 Naval Research Lab., Washington, D.C.
ATMOSPHERIC AEROSOLS NEAR THE SURTSEY VOLCANO
C. M. Gordon, E. C. Jones, and J. I. Hoover *In its* Rept. of NRL Progress Oct. 1964 p 1–3 refs (See N65-14501 05-20) OTS: $1.25

A sample of the steam-ash cloud ejected by the volcano Surtsey was collected on filter paper at an altitude of 7500 feet. Radioactivation analysis techniques were used to identify several elements in the aerosol sample, the most promigent of which were sodium-24, manganese-56, chlorine-38, and scandium-46. Author

N65-14532*# Lockheed-California Co., Burbank.
MATHEMATICAL WIND PROFILES
Arnold Court, Robert R. Read, and Gerald E. Abrahms Feb. 1964 40 p refs
(Contract NAS8-5380)
(NASA-CR-59668; LR-17683) OTS: HC $2.00/MF $0.50

Augmented Fourier polynomials, in which constant and linear terms have been added to an ordinary Fourier series, offer a means for representing the vertical profile of the horizontal wind speed. Reasons for selecting this function, and methods of its computation and application, are given. Polynomial coefficients are presented for mean monthly winds over Cape Canaveral, Florida, and for four consecutive soundings over Montgomery, Alabama. Author

N65-14548# Geophysics Corp. of America, Bedford, Mass.
ATMOSPHERIC TRANSPORT OF ROCKET MOTOR COMBUSTION BY-PRODUCTS Fourteenth Monthly Letter Progress Report
10 Dec. 1964 7 p
(Contract N123(61756)34567A(PMR))

One tracer release operation to study atmospheric transport and dispersal of rocket motor combustion byproducts emitted during static firing tests was completed. Discrepancies between the number of fluorescent tracer particles observed visually using the airborne microscope and the number collected by the airborne impinger are believed resolved by providing a light-tight hood for the observer and his microscope. Measurements of surface radiation temperatures for

San Nicolas Island and the surrounding sea area have been recorded. The pattern consists of a grid, with two orthogonal sets of parallel lines, spaced at one half-mile intervals. Coverage extended about two miles beyond the island. M.G.J.

N65-14549# McGill U., Montreal (Canada). Arctic Meteorology Research Group
HEAT TRANSPORT BY LARGE-SCALE ATMOSPHERIC WAVES DURING OCTOBER 1959–MARCH 1960 Scientific Report No. 10
Calvin E. Anderson Sep. 1964 61 p refs *Its* Publ. in Meteorol. No. 69
(Contract AF 19(604)-8431)
(AFCRL-64-856)

A spectral analysis of northward heat transport in the Northern Hemisphere was performed by the Fourier analysis method. This method was applied at 500 mb, 100 mb, and 25 mb for 5-day intervals from October 5, 1959 through March 28, 1960. A comparison of stratospheric warmings of this period with those of the previous year revealed that the heat transport could be accomplished mainly by wave numbers 1 and/or 2. From 500-mb, 100-mb, and 25-mb time sections of northward heat transport, divergences were determined to calculate the local temperature time derivatives. These derivatives were in turn compared with the actual time sections of mean temperature. This comparison showed that, due to strong convergence of northward heat transport, the winter stratosphere at high latitudes had a net ascending motion. Author

N65-14551# Hamburg U. (W. Germany). Instituts fur Radiometeorologie und Maritime Meteorologie
RADIOMETEOROLOGICAL PAPERS II
G. Fengler, H. Jeske, and G. Stilke 1964 57 p *Its* Berichte no. 9 Presented at the 1964 World Conf. on Radio Meteorology Incorporating the Eleventh Weather Radar Conf., Boulder, Colo., 14–18 Sep. 1964

CONTENTS:

1. THE INFLUENCE OF INVERSIONS ON UHF-PROPAGATION OVER LAND G. Fengler p 1–10 refs (See N65-14552 05-20)
2. DEPENDENCE OF 500 MC/S FIELD STRENGTH VALUES AND FADING FREQUENCIES ON METEOROLOGICAL PARAMETERS G. Fengler p 11–20 refs (See N65-14453 05-20)
3. TRANSHORIZON-TRANSMISSION AND HEIGHT GAIN MEASUREMENTS ABOVE THE SEA WITH WAVES IN THE RANGE OF 1.8 CM TO 187 CM UNDER SPECIAL CONSIDERATION OF METEOROLOGICAL INFLUENCES H. Jeske p 21–35 refs (See N65-14554 05-20)
4. ON METHODS AND RESULTS OF OUR REFRACTIVE INDEX MEASUREMENTS, CARRIED OUT WITH KYTOONBORNE RADIOSONDES AND AIRBORNE REFRACTOMETERS G. Stilke p 36–47 refs (See N65-14555 05-20)
5. SOME ASPECTS OF MICROPRESSURE MEASUREMENTS FOR THE EVALUATION OF INTERNAL WAVES IN THE ATMOSPHERE G. Stilke p 48–53 refs (See N65-14556 05-20)

N65-14552 Hamburg U., (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie
THE INFLUENCE OF INVERSIONS ON UHF-PROPAGATION OVER LAND
G. Fengler *In its* Radiometeorol. Papers II 1964 p 1–10 refs (See N65-14551 05-20)

The influence of elevated as well as ground inversions on uhf propagation was investigated by means of field strength measurements of four, different, long transmission paths and routine radiosonde observations. The experiments show that there exists for each transmission path a height interval where inversions are most effective. This effective height is situated higher for the longer paths. The influence of ground inversions on wave propagation depends on the thickness and intensity of the layers. Author

N65-14553 Hamburg U., (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie
DEPENDENCE OF 500 MC/S FIELD STRENGTH VALUES AND FADING FREQUENCIES ON METEOROLOGICAL PARAMETERS
G. Fengler *In its* Radiometeorol. Papers II 1964 p 11–20 refs (See N65-14551 05-20)

An analysis of simultaneously measured field-strength values, as well as fading frequencies wind velocities, is presented for some transhorizon paths. It follows that the wind velocity is only a necessary but not sufficient criterion for the existence of widespread tropospheric layers by which a high field strength level can be effected. By additional introduction of the parameter ΔN to wind velocity, where ΔN is the difference between the refractive indexes at the earth's surface and at an altitude of 1 km both quantities together prove to be sensitive criteria for predicting the field strength level to be expected. The fading frequency shows a close correlation with the component of wind velocity normal to the transmission path, especially if only observations corresponding to a well mixed atmosphere are considered. Author

N65-14554 Hamburg U., (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie
TRANSHORIZON-TRANSMISSION AND HEIGHT GAIN MEASUREMENTS ABOVE THE SEA WITH WAVES IN THE RANGE OF 1.8 CM TO 187 CM UNDER SPECIAL CONSIDERATION OF METEOROLOGICAL INFLUENCES
H. Jeske *In its* Radiometeorol. Papers II 1964 p 21–35 refs (See N65-14551 05-20)

Transmission measurements on beyond-horizon paths of several wavelengths and simultaneously performed meteorological measurements show the influence of the low-level evaporation duct in 80% of all cases and the influence of larger advection ducts or elevated inversion layers in 20% of all cases. The 80% are connected primarily with a scintillation fading type, the 20% with a longer-period interference fading. The thickness of the low-level evaporation duct can be calculated by means of simple meteorological measurements near the sea surface. The refractive-index structure in higher altitudes is derived by direct soundings of temperature and humidity with special balloon-sondes and refractometers. Height gain measurements of field strength confirm the dominating feature of ground-based ducts (evaporation ducts and advection ducts). The paths with lower antenna heights give a stronger signal strength than the paths with higher antenna heights. Author

N65-14555 Hamburg U. (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie
ON METHODS AND RESULTS OF OUR REFRACTIVE INDEX MEASUREMENTS, CARRIED OUT WITH KYTOONBORNE RADIOSONDES AND AIRBORNE REFRACTOMETERS
G. Stilke *In its* Radiometeorol. Papers II 1964 p 36–47 refs (See N65-14551 05-20)

Refractive index measurements were carried out in the area of several microwave propagation paths over the North See between coast stations and the isle of Heligoland (distances from 62 to 96 km, wavelengths from 1.8 to 187 cm) with kytoonborne radiosondes, mostly from small ships. For the evaluation of vertical gradients in boundary layers, a kytoonborne lightweight refractometer with small response time is more advantageous than an airplane microwave refractometer. In a total of about 250 kytoonborne radiosonde ascents, it was possible to measure repeatedly cases of constant gradients of the refractive index in well mixed air, as well as great alterations of the refractive index with height at conditions with advective ducts. Quasi-periodic variations of measured values in constant height have been recorded in boundary layers.

Author

N65-14556 Hamburg U. (W. Germany). Instituts für Radiometeorologie und Maritime Meteorologie

SOME ASPECTS OF MICROPRESSURE MEASUREMENTS FOR THE EVALUATION OF INTERNAL WAVES IN THE ATMOSPHERE

G. Stilke *In its* Radiometeorol. Papers II 1964 p 48–53 refs (See N65-14551 05-20)

For several years, pressure variations were recorded at 5 stations near Hamburg. The records were analyzed for those quasiperiodical pressure waves (periods from 2 to 30 min, amplitudes more than 0.02 mb) whose phases could be identified at three stations at least. The frequency distributions of periods, wavelengths, propagation velocities, and directions were derived from the phase differences of about 1100 waves of 170 wave trains that occurred during 16 months. The results for the pressure waves may be applied to the gravitational waves at a boundary layer in the atmosphere. The amplitudes of the gravitational waves and of the periodic inclination angles of the boundary layer can be computed from the amplitudes of the recorded pressure variations and the aerological data given by a radiosonde ascent.

Author

N65-14568# Consultants and Designers, Inc., Arlington, Va.

DOWNWARD CONVECTIVE FLOWS [NISKHODYASHCHIYE KONVEKTIVNYYE POTOKI]

N. I. Wul'fson and L. M. Levin 14 Dec. 1964 7 p refs Transl. into ENGLISH from Geofiz., Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 6, 1964 p 1320–1322

(Contract NAS5-3760)

(NASA-TT-F-9610; ST-AM-10259)

Theoretical estimates were made of the differences in temperature and velocity of downward convective currents as compared with ascending flows, when the unstable layer varied with the altitude. Observations confirmed that in downward streams in storm clouds, the temperature intensity and difference from the surrounding air increased with proximity to the cloud basis, while the velocities and temperatures were greater than those of updrafts in the same area. These theoretical considerations explained the cause of the phenomena and such related events as local zones of increased pressure near the ground, substantial air temperature decrease and cold wind gusts, as storm clouds passed.

M.G.J.

N65-14572 Freie U., Berlin (W. Germany). Institut für Meteorologie und Geophysik

DAILY AND MONTHLY NORTHERN HEMISPHERE 10-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964, PART 2 Second Quarterly Technical Status Report, Apr.–Jun. 1964

Barbara Kriester, Richard Scherhag, and Renate Stuhrmann Berlin, Dietrich Reimer Verlag, 1964 104 p *Its* Meteorol. Abhandl. No. 49

(Contract DA-91-591-EUC-3288)

(AD-451511)

Daily and monthly 10-millibar synoptic weather maps for the Northern Hemisphere from April to June 1964 are preceded by a discussion of the upper stratospheric circulation during the period. The similarity between stratospheric circulation in 1959 and 1964 parallels a similarity in the deviation from mean values in tropospheric levels. It is concluded that this similarity in the upper stratosphere substantiates the concept that the upper stratospheric maps will, in the near future, make a big contribution to long range weather forecasting.

E.E.B.

N65-14716# Travelers Research Center, Inc., Hartford, Conn.

RELATIONSHIPS BETWEEN TROPICAL PRECIPITATION AND KINEMATIC CLOUD MODELS Progress Report, 1 Feb.–31 Jul. 1964

Geirmundur Arnason and Edward A. Newburg [1964] 33 p refs

(Contract DA-36-039-SC-89099)

(PR-6; AD-450231)

The theory of moist convection, including formation of cloud and precipitation, is formulated. This formulation assumes a model atmosphere initially at rest and bounded vertically by two, rigid, horizontal planes and laterally by rigid vertical planes. The initial state is composed of a basic state, and of temperature and pressure perturbations superposed on the basic state. It is assumed that at all times at any given level, perturbations in pressure, temperature, and density are small compared with the initial values of these elements. The thermodynamic equation pertinent to the convection problem takes into account heat released through condensation, cooling associated with precipitation falling through unsaturated air, and turbulent diffusion. The continuity equations for water vapor, water in cloud, and precipitation include source terms expressing the bulk effects of the microphysics of cloud and precipitation.

Author

N65-14724# Texas A&M U., College Station.

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESO-SCALE SYSTEMS Sixth Quarterly Progress Report, 1 May–31 Aug. 1964

John F. Griffiths, Walter K. Henry, and Christopher Bowen 15 Sep. 1964 95 p refs

(Contract DA-36-039-SC-89202)

(Rept.-6; AD-450681)

The pattern of rainy seasons is examined for a selection of stations throughout Central America. This shows that while definite spatial patterns exist it is necessary to examine many more stations in order to obtain the general trends. In areas with sufficient data the pattern becomes identifiable. A trial run using harmonic analysis has shown the possibility of applying this approach to the mesoscale analysis. Some cases of mesoscale rainfall patterns in Western Nicaragua are shown and discussed. The data processed indicates that the rainfall in Western Nicaragua is almost entirely from mesoscale systems.

Author

N65-14788# National Science Foundation, Washington, D.C.

WEATHER MODIFICATION Fifth Annual Report, Fiscal Year Ended June 30, 1963

1964 43 p refs

(NSF-64-19) GPO: $0.25

Activities in the National Weather Modification Program are discussed in terms of sponsoring agencies. The NSF program is described, highlights are given, and grants and contracts awarded in 1963 for field investigations, laboratory and theoretical research, and statistical evaluations are summarized. Weather modification activities of the Departments of Agriculture, Commerce, Defense, and Interior, and of NASA are described briefly. Numbers and types of activities carried on by state and local activities, by commercial companies, and by overseas groups are given. Appendixes list the memberships of advisory panels and committees, tabulate federally funded weather modification programs of FY 1963, and summarize the physics of precipitation. D.E.W.

N65-14815# Joint Publications Research Service, Washington, D.C.
PROBLEMS OF SEASONAL AND MONTHLY WEATHER FORECASTS
12 Jan. 1965 87 p refs Transl. into ENGLISH from Tr. Tsentr. Inst. Prognozov (Moscow), no. 132, 1964
(JPRS-28245; TT-65-30114) OTS: $3.00

CONTENTS:
1. FORECASTING AIR TEMPERATURE FOR THE WINTER D. A. Drogaytsev p 1–49 refs
2. COMPUTATION OF THE INTENSITY OF ZONAL ATMOSPHERIC CIRCULATION IN MAKING WEATHER FORECASTS FOR A MONTH Z. G. Blinnikova and D. A. Ped' p 50–63 refs
3. EXPERIENCE OF MAKING FORECASTS OF AN ANOMALY IN THE MEAN MONTHLY AIR TEMPERATURE K. A. Vasyukov, N. I. Zverev, and G. A. Ped' p 64–70 refs
4. ON THE USE OF A HYDRODYNAMIC ANALOGY FOR WEATHER FORECASTING N. I. Zverev p 71–84 refs

N65-14974# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
ROCKETSONDE MEASUREMENT OF STRATOSPHERIC TEMPERATURE
George Q. Clark and John G. Mc Coy Dec. 1964 24 p refs
(ERDA-242; AD-453993)

This report describes a rocket system which is being used extensively for the measurement of atmospheric temperature from 65 km down to the level of balloon observation with an accuracy to within ±2% up to 60 km. The 10-mil diameter bead thermistor used in this system has a sensitivity which exceeds that of any previous temperature measuring techniques applied to the stratospheric region and has revealed the existence of a large amount of detail temperature structure throughout the stratosphere. The ease of application of this system has made possible the regular synoptic study of the temperature structure of the stratosphere, as well as the research analysis of short-term variability in the upper atmosphere. Author

N65-15030# Oklahoma U. Research Inst., Norman. Atmospheric Research Lab.
RESEARCH FOR EXAMINING CHARACTERISTICS OF CONVECTIVE SYSTEMS OF THE ATMOSPHERE, PRIMARILY OVER OCEANS, AS DEDUCED FROM CLOUDS PHOTOGRAPHED BY SATELLITES Final Report, May 1, 1962–Apr. 30, 1964
Yoshikazu Sasaki, Stanley L. Barnes, and Dayton G. Vincent 31 May 1964 115 p refs
(Contract Cwb-10332)

CONTENTS:
1. INTERACTION BETWEEN SMALL-SCALE CONVECTIVE AND LARGE-SCALE FLOW MOTION Yoshikazu Sasaki 31 p refs
2. A STUDY OF TIROS-OBSERVED CELLULAR CONVECTION USING NUMERICAL OBJECTIVE ANALYSES Stanley L. Barnes 44 p refs
3. LARGE-SCALE VERTICAL VELOCITY IN RELATION TO MESOSCALE PHENOMENA Dayton G. Vincent 38 p refs

N65-15037# Joint Publications Research Service, Washington, D.C.
ON ESTIMATING THE EFFECTIVENESS OF CLOUD MODIFICATION FOR INCREASING PRECIPITATION
G. I. Osipova and Yu. S. Fridman 22 Jan. 1965 23 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 156, 1964 p 31–45
(JPRS-28429; TT-65-30189) OTS: $1.00

Discussions are presented of a statistical method for evaluating the effectiveness of cloud modification for the purpose of increasing precipitation, and the conditions for formulation and carrying out modification experiments and determining the reliability of the use of statistical evaluation methods. Author

N65-15038# Joint Publications Research Service, Washington, D.C.
ON A METHOD OF EVALUATING CLIMATIC RESOURCES FOR ARTIFICIAL INCREASE OF PRECIPITATION FROM CONVECTIVE CLOUDS (BASED ON DATA FROM THE LAKE SEVAN BASIN)
A. P. Chuvayev et al 22 Jan. 1965 25 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 156, 1964 p 101–117
(JPRS-28431; TT-65-30191) OTS: $1.00

On the basis of an interrelated analysis of network observations of clouds and precipitation in the Lake Sevan basin, certain parameters were established indirectly characterizing the coefficient of realization of water resources in clouds in the form of natural precipitation during a convective weather regime. The possibilities of increasing precipitation by artificial cloud modification during certain weather types are discussed. Author

N65-15080# Weather Bureau, Washington, D.C.
PURPOSES AND PROGRAMS OF THE NATIONAL SEVERE STORMS LABORATORY, NORMAN, OKLAHOMA
Edwin Kessler Dec. 1964 21 p refs
(NSSL-23)

The Laboratory attempts to extend the understanding of severe convective phenomena such as tornadoes, hailstorms, and heavy rains. Particular problem areas under investigation include the following: (1) the measurement of precipitation rate by radar; (2) the application to air traffic control of ground-based weather radar and sferics equipment; (3) development of doppler radar; (4) energy conversion and transport processes and wind and water distributions; (5) the statistical characterization of weather patterns and their implications; and (6) analysis of meteorological systems and development of advanced instrumentation. P.V.S.

N65-15108# Stanford Research Inst., Menlo Park, Calif.
STUDIES OF THE CLIMATOLOGY OF WINDS, TEMPERATURE, AND TURBULENCE IN JET STREAMS Final Report

R. M. Endlich and G. S. Mc Lean Oct. 1964 72 p refs
(Contract AF 19(628)-3304)
(AFCRL-64-834; AD-608773)

CONTENTS:

1. JET-STREAM STRUCTURE OVER THE CENTRAL UNITED STATES DETERMINED FROM AIRCRAFT OBSERVATIONS p 1–22 refs

2. EMPIRICAL RELATIONSHIPS BETWEEN GUST INTENSITY IN CLEAR-AIR TURBULENCE AND CERTAIN METEOROLOGICAL QUANTITIES p 23–44 refs

3. SOME AUTOCORRELATIONS AND SPECTRA OF WIND AND TEMPERATURE IN JET STREAMS p 45–62 refs

N65-15127 Texas A & M U., College Station.
METEOROLOGICAL SATELLITE PHOTOGRAPHS AS INDICATORS OF CYCLOGENESIS AND THE RELATED CLOUD DISTRIBUTION AND STRUCTURE OVER THE GULF OF MEXICO—A CASE STUDY
Malcolm E. Gosdin (M.S. Thesis) Aug. 1964 35 p refs
(AD-605385)

The weather pattern that developed in the western Gulf of Mexico during November 19–20, 1962 was studied. Conventional data and meteorological satellite data from TIROS V were used to investigate the formation of an unstable wave on the polar front and the related cyclogenesis. Two satellite pictures, taken approximately 24 hours apart, revealed the intensification of this wave system and its associated cloud masses as it moved northward from its breeding grounds to the Texas–Louisiana coast. Lack of surface synoptic reports in the Gulf of Mexico precluded accurate location of the wave and associated fronts, but fairly accurate positions were interpreted from the cloud patterns in the TIROS photographs. These interpretations were based on the Boucher–Newcomb frontal wave model. Author

N65-15135# Pennsylvania State U., University Park. Mineral Industries Experiment Station
DATA PROCESSING FOR ISENTROPIC ANALYSES
Robert T. Duquet Dec. 1964 40 p refs
(Contract AT(30-1)-3317)
(TR-1)

A program for computing the complete set of meteorological parameters required for isentropic analysis and for cross-section analysis is presented. Except for two minor subroutines, the program was written in FORTRAN language. The input data may be specified according to several different formats, including one which is nearly identical to the international teletype code for radiosonde reports. The operations performed by the program are equivalent to the graphical procedures for processing original radiosonde observations on a Stüve diagram. Author

N65-15214# Servicio Nacional de Meteorologia e Hidrologia, Quito (Ecuador).
HYDROLOGY ANNUAL REPORT, NO. 1, 1963 [ANUARIO HIDROLOGICO NO. 1, 1963]
1964 102 p refs Includes summary of the Hydrometric Data, 1954–1963

Tables present water level data for rivers with and without tidal influence, for the mean daily discharge of various rivers, and for height, discharge, mean velocity, and cross-sectional area that were collected in 1963 on a few dates for some rivers and canals in Ecuador. Maps show the meteorologic and hydrologic network and the hydrographic river beds. D.E.W.

N65-15307# Navy Weather Research Facility, Norfolk, Va.
A HISTORICAL SURVEY OF STATISTICAL WEATHER PREDICTION
James L. Kerr Dec. 1963 30 p refs
(NWRF-41-1263-087; AD-433743)

This work presents the history of the use of statistics in weather forecasting and describes the evolution of the more important statistical methods in this field: graphical techniques, periodicity, empirical orthogonal functions, and multiple discriminant analysis. A bibliography consisting of 141 references, divided by topics, and an appendix listing these references chronologically are included. Author

N65-15314# Army Natick Labs., Mass. Earth Sciences Div.
A METHOD FOR PREDICTING THE PROBABLE FREQUENCY OF OCCURRENCE OF DAILY MAXIMUM TEMPERATURES FROM SUMMARIZED DATA
Earl E. Lackey Aug. 1964 45 p refs
(ES-13; AD-450723)

The frequency and distribution of daily maximum temperatures for any given summer month (May to September in northern hemisphere) may be predicted with a considerable degree of confidence, when only summarized data are available, by use of a multiple nomograph. The nomograph and associated table represent 45 converted mean daily maximum temperatures, having values from 36 to 80, each of which is associated with a unique numerical pattern of converted predictive temperature values. The converted mean daily maximum temperature may be computed from the following four items usually found in climatic summaries: (1) the absolute maximum, (2) the mean daily maximum, (3) the mean daily minimum, and (4) the length of record. Values on the nomograph were determined by a detailed study of the frequency occurrence of daily maximums through a 10-year period for May, July and September at 12 representative stations. The method readily lends itself to machine processing. Author

N65-15327# Air Weather Service, Scott AFB, Ill.
MAXIMUM TEMPERATURE FORECASTING TECHNIQUE FOR FELKER AAF, FORT EUSTIS, VIRGINIA
H. E. Roberton, Jr. 12 Aug. 1964 40 p refs
(AD-450856)

A method is presented for forecasting the maximum surface temperature using forecasted values of the 1000–850 millibar thickness as a first approximation. Additional corrections may be made subjectively for surface wind speed, cloud cover, precipitation, and frontal passages. Author

N65-15328# Air Weather Service, Scott AFB, Ill.
MINIMUM TEMPERATURE FORECASTING TECHNIQUE FOR FELKER AAF, FT EUSTIS, VIRGINIA
H. E. Roberton, Jr. 12 Aug. 1964 40 p
(AD-450857)

A method is presented for forecasting the minimum surface temperature using forecasted values of 1000 to 850 millibar thickness as a first approximation. Additional corrections may be made subjectively for surface wind speed, cloud cover, precipitation, and frontal passages. Author

N65-15379*# RAND Corp., Santa Monica, Calif.
AUTOMATIC PATTERN RECOGNITION OF METEOROLOGICAL SATELLITE CLOUD PHOTOGRAPHY
Y. H. Katz and W. L. Doyle Dec. 1964 95 p refs
(Contract NASr-21)
(NASA-CR-60318; RM-3412-NASA) OTS: HC $3.00/MF $0.75

The quantitative characteristics of cloud patterns were studied by determining common attributes of several pattern classes. Some mechanical procedures for automatically recognizing and classifying specific cloud patterns from satellite photography are described, and several data reduction transformations that have detected and isolated certain characteristics in which cloud "streets" differ from randomly placed cloud elements are detailed. An approach to the problem of automatically determining global cloud cover from satellite photography is also discussed. Author

N65-15397# Joint Publications Research Service, Washington, D.C.
RELATION OF WATER CONTENT AND INTENSITY OF PRECIPITATION TO RADAR REFLECTIVITY OF THE METEOROLOGICAL OBJECTS WITH DIFFERENT DROP-SIZE DISTRIBUTION PARAMETERS
A. G. Gorelik and G. A. Smirnova 29 Jan. 1965 12 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), v. 48, 1963 p 98–105
(JPRS-28547; TT-65-30233) OTS: $1.00

The theoretical relationships between radar reflectivity and water content and intensity of precipitation for different parameters of drop-size distribution are discussed. The number of drops per unit volume must be given. Theoretical ratios for rain intensity, drop velocity, and drop size are established. From the radar reflectivity the water content and intensity of rain for parameters related to drop-size distribution can be determined. Drop concentration can be calculated if the radar reflectivity and the drop-size distribution are measured. R.E.S.

N65-15411# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Meteorological Physics
DIVISION OF METEOROLOGICAL PHYSICS ANNUAL REPORT 1963–1964
1964 29 p refs

Dynamic meteorological work in progress includes investigations of fronts, mesoscale circulation jet streams, correlation of rainfall and sea surface temperatures, study of large-scale weather relationships, and theoretical studies of the effect of the earth's rotation on shallow water motions in other than axially symmetric containers. Improved instrumentation is being developed for general micrometeorological work. The accent of applied meteorology is on agriculture and the efficient use of water. Other developments concern radiation, ozone, distribution of fission debris, and weather instrumentation. R.L.K.

N65-15421# France. Direction de la Meteorologie Nationale, Paris.
CLIMATOLOGY OF THE AERODROME OF NICE-COTE-D'AZUR [CLIMATOLOGIE DE L'AERODROME DE NICE-COTE-D'AZUR]
L. Galzi, A. Tasson, R. Bubeck, and A. Basset-Terruse Oct. 1964 31 p In FRENCH *Its* Monograph No. 35

A summary of tabulations on the climatology of the aerodrome is presented. The topography of the airport is described as being acceptable from a safety standpoint with the exception of the approach from the north. Meteorological aspects presented are as follows: (1) Surface temperature of importance to jet motors is within good limits except for about 3 days a year, when it is below zero. (2) Precipitation is seasonal with two periods of heavy storms and low visibility—from October to December and a lesser period at the end of February and beginning of March. (3) Visibility is extremely good with the exception of 72 days a year, when fogs of varying degree settle in the area. (4) Low-hanging clouds are very rare because of the prevailing winds. (5) Dangerous winds are rare and usually come from the east. R.E.S.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-14694# Federal Aviation Agency, Washington, D.C.
SECOND INTERNATIONAL AVIATION R & D SYMPOSIUM. ALL-WEATHER LANDING SYSTEMS. SESSION I: AIRBORNE SYSTEMS
[1963] 122 p refs Symp. held at Atlantic City, 16–18 Sep. 1963
(AD-423916)

CONTENTS:

1. CATEGORY II LANDING APPROACH SYSTEM FOR TURBOJET AIRCRAFT R. S. Saul and F. M. Wilson 7 p
2. THE PRACTICAL DESIGN AND TESTING OF THE AUTOMATIC MONITORING SYSTEM IN THE VC 10 R. W. Howard 23 p refs
3. THE BAC ONE-ELEVEN AND ALL WEATHER LANDING G. W. Webber and S. L. Page 16 p
4. THE FLIGHT DEVELOPMENT OF A PRODUCTION AUTOMATIC LANDING SYSTEM W. H. McKinlay 33 p ref
5. A REVIEW OF THE BOEING LOWER WEATHER MINIMUMS PROGRAM FOR THE 707-720-727 AIRPLANES J. R. Utterstrom and J. R. Gannett 10 p
6. CATEGORY II OPERATION–NO PERFORMANCE COMPROMISE K. C. Kramer 24 p

N65-14856# Weather Bureau, Washington, D.C.
TROPOSPHERIC CONDITIONS OVER THE TROPICAL ATLANTIC AS OBSERVED BY TWO TIROS SATELLITES AND RESEARCH AIRCRAFT DURING 22 SEPTEMBER 1962
H. Mc Clure Johnson and Robert W. Fett Jun. 1964 97 p refs
(MSL-29)

The summarized meteorological information obtained by Tiros V and Tiros VI, as well as concurrently obtained observations from two well-instrumented aircraft, is presented. Atmospheric systems and the details of their structure, clouds and motions were observed, and the relationship between aircraft observations and satellite observations was investigated. Data were gathered for the early stages of tropical cyclones; intertropical convergences and their associated phenomena; other synoptic scale atmospheric systems, including the characteristics of the northeasterly trade flow; states of the atmosphere and their characteristic cloud patterns; and small-scale conditions at areas with trade cumulus lines and bands. G.G.

N65-15190*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
CONING DAMPER CONTROL SYSTEM ANALYSIS BOUND PROJECT, MODEL NO. DSV-5

M. J. Abzug, D. W. Goldberg, C. F. Harding, and J. M. Lutz Mar. 1962 74 p refs
(Contract NAS5-1294)
(NASA-CR-60252; SM-41560) OTS: HC $3.00/MF $0.75

The coning damper effectively maintains a desired spatial orientation of the spinning spacecraft. During coast periods it senses coning motion about the angular momentum vector and adds energy to the vehicle to overcome energy losses from internal vibration. It also reduces coning due to tipoff rates or any other coning angle sources. An analysis is included of external disturbing influences affecting the vehicle spatial orientation. These disturbances are outside the influence of the control system. A separate section of the report is devoted to an alternate control scheme employing an attitude gyro as the controller. Author

N65-15191*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
PRELIMINARY DESIGN OF AN ACTIVE CONING DAMPER FOR THE REBOUND SPACECRAFT
R. L. Jenks Mar. 1962 32 p ref
(Contract NAS5-1294)
(NASA-CR-60230; SM-41586) OTS: HC $2.00/MF $0.50

Spin stabilization was selected as a reliable and simple attitude control system for the Rebound spacecraft. To eliminate "coning", i.e., movement in the pitch or yaw axis while spinning in the roll axis, a Rebound coning damper was developed. In determining the environmental and operational requirements and systems design necessary, energy states for a vehicle spinning about its roll axis, rotation of angular momentum vector in pitch and yaw axes, energy loss considerations, and reduction of coning angle were studied. Preliminary data show that such a damper would maintain the alinement of the vehicle's spin axis with its total angular momentum vector, enabling accurate injection of the payload into orbit. Reliability is estimated at better than 0.999. M.G.J.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-14584# Portugal. Nuclear Energy Commission, Sacávem. Laboratório de Física e Engenharia Nucleares
COMPARATIVE STUDY OF THE PERFORMANCES OF AN AUTOMATIC PILOTING SYSTEM BY "ALL OR NOTHING" FOR A NUCLEAR REACTOR [ETUDE ANALOGIQUE DES PERFORMANCES D'UN SYSTEME DE PILOTAGE AUTOMATIQUE PAR "TOUT OU RIEN" POUR UN REACTEUR NUCLEAIRE]
G. Chazal and J. Menezes (Commissariat a l'Engergie Atomique, Saclay (France)) [1964] 84 p
(LFEN-NI-14(β))

A system proposed for the regulation of the power level of a high-flux experimental pile is described. This system consists of an error amplifier or comparator which gives a signal proportional to the difference between the detector output signal and the reference signal, a relay-motor ensemble to automatically shift the control rod, and a correcting network to improve performance. A comparative calculator is used to study the performance by calculating the nonlinearity of the reactor and the auxiliary mechanism. A physical description of the reactor, the comparative equations and variables, and a schematic diagram are presented. Conclusions show the relative variation of the power of the reactor and the reactivation introduced by the control rod. R.E.S.

N65-14595# Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
CRACK PROPAGATION TESTS ON NORMAL AND HYDRIDED ZIRCALOY-2 REACTOR PRESSURE TUBING
R. C. Aungst and L. J. Defferding Aug. 1964 24 p ref
(Contract AT(45-1)-1350)
(HW-80567) OTS: $2.00

Two methods were developed for introducing a crack in specimens of pressure tubing under controlled conditions of temperature and stress. With these methods data have been generated defining the effects of temperature, degree of cold work, flaw size, hydrogen content, and a moderate amount of irradiation on susceptibility to brittle fracture. The tests indicate that at elevated temperatures likely to be encountered in reactor operation no tendency exists toward brittle fracture arising from defects about 1/2 in. long. At 150° C and below, susceptibility to brittle failure increases with degree of cold work. Increasing hydrogen content of a Zircaloy-2 tube containing a flaw lowers its resistance to brittle failure at room temperature and increases the sensitivity of the test to flaw size. Exposure for up to 4 years in a production reactor does not appear to affect the room temperature brittle factor characteristics. Author

N65-14689# Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.
PROGRESS ON A FAST-DRIFT METHOD FOR MAKING LITHIUM-ION-DRIFT GERMANIUM p-i-n GAMMA-RAY SPECTROMETERS
A. J. Tavendale and I. L. Fowler Nov. 1964 10 p refs Revised Available from Atomic Energy of Canada, Chalk River: $0.50
(AECL-2110; GPI-57)

A method for the fabrication of large area, deep depletion depth, germanium p-i-n diodes is described in which temperature control and removal of excess heat from the diodes during drift is accomplished by immersing them in boiling chloroform. The improvement of speed over air drifting is about a factor of five, the settings of the control rheostat are quite uncritical, and thermal runaway is not encountered. This technique has been applied to large diodes (6 cm^3) with up to 11-mm depletion layer depth. D.S.G.

N65-14696# European Atomic Energy Community, Brussels (Belgium).
RESEARCH CARRIED OUT UNDER THE EURATOM/UNITED STATES AGREEMENT
P. Kruys et al 1964 180 p refs
(EUR-1840.e) Available from Belg. Am. Bank and Trust Co., N.Y., account no. 22.186: 250 Belg. Fr.

CONTENTS:
1. THERMOHYDRODYNAMIC STUDIES ON TWO-PHASE FLOW R. Morin p 7–86

2. CORROSION AND OXIDATION STUDIES CARRIED OUT UNDER THE UNITED STATES/EURATOM AGREEMENT Ph. Berge p 87–110 refs

3. THE CAUSES OF EMBRITTLEMENT IN STEELS FOR NUCLEAR REACTOR VESSELS Jean Sebille p 111–154 refs

4. EURATOM'S ACTIVITY IN THE FIELD OF URANIUM OXIDE P. Fernet p 155–180 refs

N65-14707# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

TECHNIQUES FOR PERFORMING IN-REACTOR STRESS-RUPTURE EXPERIMENTS

J. W. Woods Jan. 1965 20 p refs
(Contract W-7405-ENG-26)
(ORNL-3724) OTS: $1.00

Techniques developed for performing tube-burst tests are discussed and illustrated. Fabrication of specimens, heaters, and experiment containers is described. Detailed instructions are given for the operation of an experiment.

Author

N65-14708# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

STRESS-STRAIN MEASURING SYSTEM FOR IN-REACTOR USE IN HIGH NEUTRON FLUX

W. W. Davis and C. R. Kennedy Jan. 1965 10 p refs
(Contract W-7405-ENG-26)
(ORNL-3747) OTS: $1.00

This report describes a system for creep testing graphite specimens under an irradiation flux field of 2×10^{13} neutrons cm^{-2} sec^{-1} ($E > 1$ MeV) in a poolside facility of a reactor. Differential pressure across stainless-steel bellows is used to load parabolic cantilever-beam creep specimens. A linear resistor as a potentiometer in a null balance circuit continuously measures the strain as the deflection of the parabolic specimens. The resulting overall sensitivity of the strain measurement was about 10^{-6}. This system has demonstrated its ability to endure the irradiation environment, and it can be modified easily for testing of a variety of materials.

Author

N65-14811# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

DESIGN STUDY REPORT FOR TARGET—A 1000-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR

Washington, AEC, Nov. 1964 208 p refs
(Contract AT(04-3)-167)
(GA-4706) OTS: $6.00

Preliminary designs and cost estimates incorporated alternative design features for a number of plants using the HTGR system. Cost studies on the alternative types of primary system pressure containment indicated that the use of a prestressed concrete vessel that contains not only the reactor core but the steam generators and circulators is cheaper than a steel vessel. The two basic types of reheats considered were gas reheat and steam reheat. With either of these two systems, both single and double reheats are possible. Results indicated that the single-gas-reheat plant power costs were less than the cheapest steam reheat. Consideration of plant designs using both fission-product releasing fuel and fission-product retaining fuel and having BeO or graphite spines indicated that, although total costs for the releasing fuel system may be less, the uncertainties in the basic concept make the selection of the retaining fuel for the reference design preferable. Of the two types of main helium coolant circulators considered, the series-steam-turbine-driven circulator was recommended over the turbocirculator.

D.S.G.

N65-14819# Atomic Energy Commission, Washington, D.C. Div. of Reactor Development

NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM Summary Report

P. Cybulskis, H. L. Hamester, R. R. Newton, E. H. Davidson, W. K. Kern et al Nov. 1964 93 p refs
(WASH-1052) GPO: $0.50

The nuclear safety research and development program includes a comprehensive analytical, experimental, and engineering-scale test effort to develop information essential for the safe design, construction, and operation of nuclear facilities. Technological areas covered include reactor kinetics, chemical reactions (e.g., metal-water, metal ignition, fission product phenoma), reactor containment, and fast reactor safety. Integral engineering-scale testing of terrestrial and aerospace nuclear systems is discussed, as are environmental studies of radioactive effluents. Nuclear safety analysis and evaluation methods and procedures are evaluated.

R.W.H.

N65-14867# Argonne National Lab., Ill.

CHEMICAL ENGINEERING DIVISION Semiannual Report, January–June 1964

R. C. Vogel, Milton Levenson, and F. R. Masten Aug. 1964 339 p refs
(Contract W-31-109-ENG-38)
(ANL-6900) OTS: $7.00

Chemical–metallurgical processing, fuel cycle applications of volatility and fluidization techniques, high-temperature reactor materials development, calorimetry, reactor safety, energy conversion, nuclear constants, and analytical research and development are reported.

E.E.B.

N65-14875# Technische Hogeschool, Eindhoven (Netherlands).

THE ONSET OF HYDRAULIC INSTABILITIES IN AN ANNULAR CHANNEL

C. L. Spigt, F. J. M. Dijkman, and M. Bogaardt Brussels, EURATOM, Jul. 1964 37 p Presented at the EAES-Symp., Studsvik, Sweden, 1–3 Oct. 1963
(Contract EURATOM-032-60-11 RDN)
(EUR-1457-e; EURAEC-857) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22-186: 60 Belg. Fr.

The results of an experimental study of the onset of instabilities in a vertical boiling channel are presented. An attempt is made to define a suitable criterion for the onset of instabilities using autocorrelations and power density curves. The character of the instabilities was studied by means of a multistage impedance void detector. The onset of instabilities is presented as a function of pressure and inlet subcooling. Particular flow patterns observed in an atmospheric boiling loop are shown.

Author

N65-14938# Hanford Atomic Products Operation, Richland, Wash.

CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Jul.–Sep. 1964

[1964] 77 p refs
(Contract AT(45-1)-1350)
(HW-81602) OTS: $3.00

Studies on ceramic fuel research, irradiation behavior of ceramic fuels, plutonium recycle fuel, fuel element fabrication and performance, and fabrication of fuel for physics studies are summarized. E.E.B.

N65-14971 United Kingdom Atomic Energy Authority, Culham (Gt. Brit.) Culham Lab.
MAGNETIC MIRROR MACHINES—A BIBLIOGRAPHY
L. S. Francis, comp. Feb. 1964 43 p refs
(CLM-Bib-5) HMSO: 5s

N65-15001# Oak Ridge National Lab., Tenn. Chemical Technology Div.
DETERMINATION OF NUCLIDE CONCENTRATIONS IN SOLUTIONS CONTAINING LOW LEVELS OF RADIOACTIVITY BY LEAST-SQUARES RESOLUTION OF THE GAMMA-RAY SPECTRA
E. Schonfeld, A. H. Kibbey, and W. Davis, Jr. Jan. 1965 56 p refs
(Contract W-7405-ENG-26)
(ORNL-3744) OTS: $3.00

Tests, with two multichannel spectrometers, and data analyses by the method of least squares, using a high speed computer, were made with solutions of ^{60}Co, ^{85}Sr, ^{141}Ce, and ^{144}Ce added as tracers to water containing ^{90}Sr, ^{95}Zr-Nb, ^{106}Ru, ^{134}Cs, and ^{137}Cs. The lowest concentration of radioactivity was about one-tenth of the lowest value previously determined by this technique; that is, down to 10 counts/min. Evaporation by factors up to 20 was also evaluated for improving accuracies of analyses. For comparison, the solutions were also analyzed by standard radiochemical methods. Several contributions to the mathematical techniques of gamma-ray spectrum resolution are reported. Author

N65-15133# Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
MEASURING AND CORRELATING NEUTRON EXPOSURE AND DAMAGE IN GRAPHITE
R. E. Dahl Dec. 1963 18 p refs
(Contract AT(45-1)-1350)
(HW-79793) OTS: $0.50

A procedure is described for measuring neutron exposure to graphite and for correlating radiation-damage data from different types of reactors. The fast-neutron spectrum is calculated and is, in turn, used to calculate the activation in threshold monitors such as nickel and iron. Nickel and iron are activated by neutrons with energies greater than about 3 MeV, so an effective cross section is computed to calculate exposures to neutrons with energies greater than 0.18 MeV. With these effective cross sections, activation monitors at several reactors yield exposures in agreement to ±10%. The ratio of gross atomic-displacement rate to the flux greater than 0.18 MeV was constant within 10% in several neutron spectra. If the magnitude of radiation-induced changes is proportional to displacement production, data from various reactors can be related by the exposure unit, nvt ($E > 0.18$ MeV). Conversion units from megawatt day per adjacent ton to integrated fast flux were tabulated. Results are 1.19×10^{17} nvt/(Mwd/At) in the Hanford K-Reactor and 0.96×10^{17} nvt/(Mwd/At) in the Hanford C-Reactor. Author

N65-15193# Spezialfabrik für Hochvakuum- und Elektrotechnik, Vienna (Austria).
A NEW METHOD FOR OBTAINING CONTROLLED ATOMIC NUCLEAR FUSION [EIN NEUES SYSTEM ZUR ERZIELUNG KONTROLLIERTER ATOMKERNFUSION]
Karl Nowak [1964] 10 p refs In GERMAN

Deuterium gas and electrons were used to form a fusion plasma inside a high-vacuum reaction chamber. The fusion temperature of the deuterium ions was controlled by magnetic acceleration, followed by horizontal confrontation with the atom ions. This gives almost all deuterium ions uniform temperature velocity and leads to a relatively easy compression of the plasma. The electrons are introduced vertically into the deuterium gas for atomic fusion. This method is suitable for small reactors to be used in rocket propulsion, and in ship and power generators, etc. G.G.

N65-15202 Société des Forges et Ateliers du Creusot (France).
THE USE OF AUSTENITIC STEEL AS CONSTRUCTION MATERIAL FOR THE PRESSURE VESSEL OF THE FAST REACTOR "RAPSODIE" [CHOIX ET MISE EN OEUVRE D'UN ACIER AUSTENITIQUE POUR LA CONSTRUCTION DE LA CUVE DU REACTEUR A NEUTRONS RAPIDES RAPSODIE]
A. Guegnaud and C. Roques Brussels, EURATOM, 1964 30 p refs In FRENCH; ENGLISH summary Presented at a Symp. on the "Materiaux pour Reacteurs Refroidis Au Sodium", New York, 19 Nov. 1963
(Contract EURATOM-006-62-1 RAAF)
(EUR-1642.f) Available from Belgian Am. Bank and Trust Co., N.Y. Account No. 22.186: 40 Belg. Fr.

An 18/8 austenitic steel has been selected to obtain satisfactory resistance to corrosion and creep at 540° C. Special studies on the development of such a steel concerned the following points: (1) Determination of the composition of the steel—the creep tests on 18/8 steels containing molybdenum or niobium additions showed the former to be completely imperious to notch impact in the base metal zone affected by the welding heat. (2) Determination of the optimum structure of the weld-deposited metal—cracking and embrittlement tests showed it was essential to obtain a delta ferrite content of between 3% and 6%. No fabrication incidents occurred during the welding and heat-treatment of the vessel mockup, which is made of 17 Cr-13Ni-2Mo steel and welded with electrodes having a controlled ferrite content. Author

N65-15339# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING SEPTEMBER, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Oct. 1964 41 p refs
(Contract W-7405-ENG-92)
(BMI-1694(Del.)) OTS: $1.00

Summaries are given of work in various fields concerning atomic energy in civilian applications. Fields summarized are reactor materials and components, fuels studies, radioisotope and radiation applications, coated-particle fuel materials, corrosion studies of the fluoride-volatility process, and the gas-cooled reactor program. D.E.W.

N65-15342# Los Alamos Scientific Lab., N. Mex.
TEMPERATURE DEPENDENT KINETICS OF COUPLED-CORE REACTORS
C. G. Chezem and R. L. Seale 1 Dec. 1964 95 p refs
(Contract W-7405-ENG-36)
(LA-3148-MS) OTS: $3.00

The kinetic behavior of arrays of nuclear reactors was investigated. Included is the influence of temperature-reactivity effects. The coupling magnitude (a) strongly influences the transfer function amplitude at all frequencies. The influence

of the coupling lag time (τ) is apparent only at high frequencies, and significant effects are present only if α is high (~ 0.01) and the neutron lifetime (l) is short such that $\beta\tau/l \sim 1$. The temperature-reactivity effects are restricted to the low-frequency domain. No apparent limitations, induced by neutronics, on the use of coupled-core systems were discovered over the range of parameters which were investigated. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-14499# Raytheon Co., Norwood, Mass.
VERTICAL ELECTRIC DIPOLE IN A TWO-CONDUCTOR REGION Scientific Report No. 4
James F. Carolan Apr. 1964 37 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-730; AD-609685)

The vertical electric fields due to a vertical electric dipole immersed in a dissipative rock medium (dielectric or conductor) situated below a highly conducting overburden (conductor) have been developed. Equations are developed to show similarities and differences between the air–conductor and conductor–conductor cases. Expressions are valid in the near-zone region for the conductor–conductor case. For the three-medium case in practice, viz., air above overburden above rock, when the air–overburden presents a small correction to the two-medium conductor–conductor case, expressions valid for the far zone are given. Author

N65-14658*# National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
PRESSURE MEASUREMENTS IN CRYOGENIC SYSTEMS
P. Smelser [1962] 21 p refs Presented at the 1962 Cryog. Eng. Conf., Calif. U., 14–16 Aug. 1962
(NASA Order R-45)
(NASA-CR-50288) OTS: HC $1.00/MF $0.50

Some of the problems associated with pressure measurements in cryogenic systems are presented. These problems can in many cases be eliminated by using pressure transducers at cryogenic temperatures. Tests were conducted on a few types of commercially available transducers to determine their suitability for operation at temperatures down to 20° K. The results of these tests indicate that accurate pressure measurements can be made at cryogenic temperatures by using some of these types if their calibration is checked each time they are cooled down. Author

N65-14700# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
A PROGRAM FOR CALCULATING THE KINEMATICS OF A TWO-BODY REACTION (IBM 7040 ELECTRONIC COMPUTER) [PROGRAMMA PER IL CALCOLO DELLA CINEMATICA DI UNA REAZIONE A DUE CORPI (CALCOLATORE ELETTRONICO IBM 7040)]
G. Campos Venuti and D. Giucci 10 Jul. 1964 155 p refs In ITALIAN; ENGLISH summary
(ISS-64/27)

A program is described for calculating the kinematics of a two-body reaction with a target at rest. Three variables, each characterized by different input parameters, allow the calculation of energies, angular distribution and angular correlations between reaction products. The program was compiled in double-precision MAP for the IBM 7040 electronic computer. Author

N65-14745# Joint Publications Research Service, Washington, D.C.
THE PHILOSOPHICAL CONTENT OF THE THEORY OF RELATIVITY
Tamas Schuck 31 Dec. 1964 22 p refs Transl. into ENGLISH from Valosag (Budapest), v. 7, no. 9, Sep. 1964 p 23–35
(JPRS-28073; TT-65-30029) OTS: $1.00

Several arguments are presented to counter the statement that Einstein's theory of relativity is "an inverted, objective, idealistic concept embellished with positivist features and incompatible with the point of view of dialectic materialism." The overall view held is that, if a theory pertaining to physics or any other science correctly reflects reality, its philosophical content is necessarily materialistic, regardless of the personal views of its originator. M.G.J.

N65-14768 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF THE OPTIMAL CONDITION OF A REACTOR OF CONTINUOUS EFFECT
N. D. Dazkesa-Manskiy *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 76–87 refs (See N65-14762 05-10) OTS: $6.00

On the basis of the mathematical expectancy of a process, the problem of the construction of optimal conditions is formulated for a heterogeneous catalytic reactor of the tubular type. A procedure is investigated for solution of the problem by combining an analytical investigation based on Pontryagin's maximum principle with research using a model. Results are presented for a solution of the problem by the indicated procedure. Author

N65-14859# Aerospace Corp., El Segundo, Calif.
APPROXIMATE SOLUTIONS OF THE LATERAL MOTION OF RE-ENTRY VEHICLES DURING CONSTANT ALTITUDE GLIDE
H. E. Wang 25 Feb. 1963 61 p refs
(Contract AF 04(695)-169)
(TDR-169(3560-10)TN-1; SSD-TDR-63-60; AD-402079)

Approximate analytic solutions were obtained to the lateral motion of reentry vehicles during constant altitude glide. The constant altitude glide is maintained by banking the vehicle about its velocity vector at a fixed angle-of-attack. The approach taken is to first treat the flat earth case and then include the spherical earth correction. Simple expressions were obtained for the turn angle, lateral range angle, and the down range angle. A comparison with exact numerical solutions shows that the approximate solutions are sufficiently accurate for preliminary design purposes. The approximate solutions, although simple, contain all the characteristics of the glide mode in question. The results show that the lateral range, being a function of $W/(C_D A \rho)$, exhibits a maximum for a given L/D and initial velocity for the spherical earth case. In the flat earth case, the maximum exists for suborbital and orbital initial velocities and ceases to exist above a certain initial velocity depending on L/D. Author

N65-14923 Joint Publications Research Service, Washington, D.C.
CALCULATION OF SOME ELASTIC ELEMENTS OF INSTRUMENTS
V. N. Zheludkov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 221-232 refs (See N65-14894 05-14)
OTS: $6.00

This article analyzes the flexure of a plane elastic element in the region of low nonlinearity on its loading by centered force and moment. The results so obtained constitute a generalized solution of the problem of flexure with different values of longitudinal and transversal force, except for longitudinal flexure. The article shows the use of the derived equations in calculation of an elastic guide of the type of a strip hinge. Author

N65-14935*# Stanford U., Calif.
GRAVITATIONAL AND RESONANCE EXPERIMENTS ON VERY LOW-ENERGY FREE ELECTRONS AND POSITRONS Progress Report, 1 Feb.-1 Dec. 1964
William M. Fairbank [1964] 5 p refs
(Grant NsG-378)
(NASA-CR-60104) OTS: HC $1.00/MF $0.50

The lower limit of electron energies was reduced to about 10^{-11} electron volts by increasing the length over which the drift tube was free of magnetic fields. This was done with a superconducting shield. An experiment indicated that there are three main factors which affect the accuracy with which g-2 can be measured: (1) the time of flight of the free electrons; (2) the stability of the oscillating field; and (3) the homogeneity of the magnet. Pilot model results proved that time of flight is no limitation, and a continuous microwave source which is stable to better than 1 part in 10^{11} was assembled and tested. Calculations showed that it is feasible to build a magnet with sufficient homogeneity to make a measurement of g-2 to 1 part in 10^{8} possible. The drift tube, resonant cavity, dewar, and vacuum system were constructed and partially tested. R.R.D.

N65-14958*# State U. of Iowa, Iowa City.
THE ALFVEN INVARIANT IN THE FIELD OF A MAGNETIC UNIPOLE
J. A. Van Allen Nov. 1964 4 p refs
(Grant NsG-233-62)
(NASA-CR-60141; SUI-64-36) OTS: HC $1.00/MF $0.50

Equations and references are given to call attention to the fact that the Alfven quantity, $\sin^2 \alpha/B$, is a rigorous constant of the motion of an isolated, electrically charged particle in the field of a magnetic unipole. M.G.J.

N65-15008# Rochester U., N.Y.
THEORETICAL STUDIES OF THE ELECTROMAGNETIC FIELD IN THE FOCAL REGION OF COHERENT LIGHT BEAMS Final Report, Aug. 1, 1962-Jul. 31, 1964
Emil Wolf Aug. 1964 26 p refs
(Grant DA-ARO(D)-31-124-G325)
(AD-604601)

An electromagnetic field structure theory has been applied to obtain details about the focal region in an aplanatic system which focuses a plane, monochromatic, linearly polarized, electromagnetic wave. Results show that by focusing intense laser beams, longitudinal field strengths of 100,000 V/cm can be attained. These calculations refer to a wave whose amplitude distribution on emergence from the lens is appropriate to aplanatism, while the amplitude distribution of a maser beam has a more complicated structure. However, suitable amplitude filters could be used to convert the maser output distribution into an aplanatic one. Brief summaries of related studies on this problem are also presented. M.G.J.

N65-15046# California U., La Jolla.
QUANTUM DENSITY OSCILLATIONS IN AN INHOMOGENEOUS ELECTRON GAS
W. Kohn and L. J. Sham [1964] 37 p refs
(Contract Nonr-2216(11))
(TR-27; AD-607712)

An infinite system of electrons in its ground state, subject to a very slowly varying external potential, has slowly varying properties and can be described by a gradient expansion theory. However, when in addition either (1) there is a spatially rapidly varying perturbing potential, or (2) there are regions in which the electron density drops to zero (e.g., electrons in an oscillator potential), the density and other properties of the system exhibit additional spatial oscillations, called quantum oscillations (e.g., the Friedel oscillations in metals). A general theory of these oscillations for one-dimensional, noninteracting electrons is developed. Illustrations are worked out which show that, when the quantum oscillations are superposed on the smooth "semiclassical" results, very accurate approximations to the exact densities can be obtained. Author

N65-15086# National Physical Lab. of Israel, Jerusalem.
THE EVALUATION OF THE OPTICAL CONSTANTS OF A THIN INHOMOGENEOUS LAYER Technical (Scientific) Note No. 1
E. Wajsberg 1 Jul. 1964 9 p refs
(Contract AF 61(052)-659)
(AFCRL-64-818; AD-608493)

The true optical constants of a thin inhomogeneous layer coated on a base are evaluated from a knowledge of the magnitude and phase of the complex reflection coefficient and their derivatives with respect to film thickness. These measured quantities furnish sufficient information to determine the film constants without requiring knowledge of the substrate properties.

N65-15166# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SYMMETRICAL COUPLING OF THREE ANGULAR MOMENTA
Monique Lévy-Nahas and Jean-Marc Lévy-Leblond Nov. 1964 24 p refs
(TH-75)

A new coupling scheme for three angular moments is given. It relies on the properties of an operator which depends democratically upon the three individual angular momenta—this is in fact their mixed product. This operator, the total angular momentum, and one of its components form a complete set of commuting observables. In the case where the three individual angular momenta are equal, the eigenstates of this set possess remarkable symmetry properties with respect to the permutation group S_3. Author

N65-15195# Washington State U., Pullman.
INTERACTIONS OF ACTIVATED GASES WITH SOLIDS Semiannual Operating Report, 1 May-10 Oct. 1963
E. E. Donaldson Nov. 1963 6 p refs
(Grant AF-AFOSR-62-86)
(Rept.-3; AD-434410)

Carbon monoxide was desorbed from nickel, iron, and zirconium by irradiation of the metal surfaces with photons of the wavelengths 2000 Å to 6000 Å. The photo desorption efficiency depended on the wavelength with maximal effects for nickel at 2700 Å, for zirconium at 2500 Å, and for iron in the visible region of the spectrum. In another study, curvature, area, and polarity effects of electrodes were found to be important in electrical breakdown in the 0 to 60 kV range. A new electrode breakdown hypothesis is presented: The energy needed to initiate electrical breakdown is equal to a fraction of the capacitively stored energy of the electrodes. In a study of adsorption of gases activated by electron impact, electron impact was found to dissociate the N_2^+ ions from nitrogen, leading to the subsequent adsorption of the atomic nitrogen on a metal surface. Other methods of nitrogen gettering by a hot tungsten filament also indicated nitrogen dissociation and subsequent adsorption of the atomic nitrogen. G.G.

N65-15200# Hebrew U., Jerusalem (Israel).
RESEARCH ON OPTICS OF SELECTIVE SURFACES Final Report, 1 Sep. 1959–31 May 1963
H. Tabor [1963] 47 p refs
(Contract AF 61(052)-279)
(AFCRL-64-351; AD-606656)

Described are chemical, optical, and mathematical investigations of thin absorbing films on metal substrates intended for solar energy absorbers. This study was concerned with nickel-black coatings produced by electrodeposition. It was shown that the chemical and optical properties of these coatings vary with thickness and with the conditions in the plating bath. New optical and mathematical techniques were developed to determine the optical constants of thin absorbing layers and how to manipulate them to produce filters with the desired characteristics. Early selective surfaces of this kind used a pair of different nickel-black layers on a metal base, and passable filter properties were obtained. Development of the theory for these surfaces suggested the addition of an intermediate layer (metallic) to produce a three-layer system with a very broad interference region in the solar spectrum. It was concluded that although nickel-black coatings are used commercially on low-temperature solar collectors (for water heating), they are not suitable for higher temperatures or for a space environment. Consequently, some work was started on other "blacks" such as chromium-black. R.R.D.

N65-15231*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRACTURE TOUGHNESS TESTING
John E. Srawley and William F. Brown, Jr. Washington, NASA, Jan. 1965 69 p refs
(NASA-TN-D-2599) OTS: HC $3.00/MF $0.50

A comprehensive survey is presented of current methods of fracture toughness testing that are based on linear elastic fracture mechanics. General principles are discussed in relation to the basic two-dimensional crack-stress-field model and in relation to real three-dimensional specimens. The designs and necessary dimensions of specimens for mixed-mode and opening-mode (plane strain) crack-toughness measurement are considered in detail. Methods of test instrumentation and procedure are described. Expressions for the calculation of crack-toughness values are given for the common types of specimens. Author

N65-15240# Purdue Research Foundation, Lafayette, Ind.
THE BORN APPROXIMATION APPLIED TO ELECTROMAGNETIC SCATTERING FROM A FINITE CONE Scientific Report, No. 2
D. B. Hodge and F. V. Schultz Sep. 1964 70 p refs
(Contract AF 19(628)-1691)
(AFCRL-64-762; TR-EE64-18; AD-609724)

This report contains a discussion of the Kirchhoff, or physical optics approximation used in determining the fields scattered from perfectly conducting obstacles. The basic assumptions implicit in this method are investigated, and it is shown that this method fails to predict the depolarization phenomenon expected when obstacles lacking symmetry are considered. Finally, the Born approximation is applied to the determination of the fields scattered from a perfectly conducting finite cone immersed in a plane electromagnetic wave. The second Born approximation is calculated using spherical eigenfunction expansions. The numerical investigation indicates that this solution converges slowly. Author

N65-15281# Martin Co., Denver, Colo.
CRYOGENIC MATERIALS DATA HANDBOOK
F. R. Schwartzberg, S. H. Osgood, R. D. Keys, and T. F. Kiefer Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 626 p refs
(Contract AF 33(657)-9161)
(ML-TDR-64-280; PB-171809, Rev.; AD-609562)

This handbook contains mechanical and physical property data on 62 metallic and nonmetallic materials organized in eight sections. It also contains material, property, and accumulative indexes and reference list. Progress reports to update and maintain the handbook will be issued semiannually. Author

N65-15304# California U., Berkeley. Inst. of Engineering Research
A GENERAL THEORY OF AN ELASTIC-PLASTIC CONTINUUM
A. E. Green and P. M. Naghdi Sep. 1964 67 p refs
(Contract Nonr-222(69))
(AM-64-16; AD-606143) OTS: $3.00

Full use was made of thermodynamical equations in developing an elastic–plastic continuum theory, with no restrictive assumptions on the smallness of strains or isotropic materials. Certain kinematical results, and the relevant dynamical and thermodynamical equations for any continuum were collected, prior to a consideration of the constitutive equations of modern nonlinear continuum mechanics. Using an energy balance equation and an entropy production inequality, together with invariance conditions under superimposed rigid body motions, the basic theory was outlined, and both the material and spatial descriptions of the basic field equations were recorded. Main results from the theory of large deformation of an elastic body, including thermodynamical equations in terms of free energy and the Gibbs function, were also given. In constructing constitutive equations, a geometrical formalism was employed and the state of stress referred to a point in six-stress space with rectangular cartesian coordinate axes, labeled by the components of a symmetric stress tensor. Special applications of the general theory are also discussed. M.G.J.

N65-15306# Ampex Corp., Redwood City, Calif.
THE THEORY OF THE INFINITELY WIDE, PERFECTLY FLEXIBLE SELF-ACTING FOIL BEARING
A. Eshel and H. G. Elrod, Jr. (Columbia U.) Dec. 1964 30 p refs
(RR-64-14)

The differential equations applicable to the film thickness beneath an infinitely wide, perfectly flexible, self-acting tape are derived. Accurate numerical solutions are obtained for the film thickness in both the entrance and exit regions. These

solutions have general applicability to situations where the entrance and exit regions are separated by a third region of uniform thickness. Author

N65-15343# California U., Berkeley. Lawrence Radiation Lab.
SURFACE IONIZATION OF Na, Rb, Lil, AND NaI ON TUNGSTEN, RHENIUM, AND PLATINUM-TUNGSTEN
Kent R. Wilson and Richard J. Ivanetich 25 Aug. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-11606) OTS: $2.00

The ionization of Na, Rb, Lil, and NaI was measured on tungsten, rhenium, and 92% platinum-8% tungsten surfaces as a function of surface temperature. The results are compared with the predictions of the Saha–Langmuir equation, and deviations are discussed. The technique of differential surface ionization is shown to distinguish between Li and Lil and between Na and NaI. The role of surface contamination is discussed. Rhenium is shown to give more efficient surface ionization than tungsten for Na, NaI, and Lil. Author

N65-15358# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (W. Germany). Institut für Energiewandlung und Elektrische Antriebe
ANALYSIS OF MAGNETIC FIELD-CONFIGURATION OF A CURRENT LOOP THEORETICAL CALCULATION OF THE r- AND z-COMPONENTS OF A CONICAL COIL [ANALYSE DER MAGNETISCHEN FELDKONFIGURATION EINER STROMSCHLEIFE ZUR QUANTITATIVEN BESTIMMUNG DERAXIALEN UND RADIALEN FELDKOMPONENTEN EINER KONISCHEN SPULE]
A. Meert Aug. 1964 32 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-16; DVL-362) Available from ZLDI, München: DM 9,30

The report deals with the theoretical calculation of the magnetic field of a conical coil using the following parameters: diameter, length, and angle of the coil. As a result of the theoretical treatment of the problem, an explicit expression for the r- and z-components of the magnetic field is obtained. Using these functions it is possible to calculate the magnetic field. In the special case of a current loop the coefficients of the functions are derived and plotted in a graph. Author

N65-15362*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
BOUNDARY LAYER NOISE RESPONSE SIMULATION WITH A SOUND FIELD
Richard H. Lyon Apr. 1964 30 p refs For Presentation at the 2d Intern. Conf. on Acoustical Fatigue Sponsored in part by NASA
(NASA-CR-56074) OTS: HC $2.00/MF $0.50

Simulation of vibration, fatigue, and malfunction response of space vehicles to acoustic pressure waves during prelaunch and launch phases is discussed. It is not feasible to reproduce turbulent loading conditions, but the resonant response of a boundary layer can be simulated by the response to a sound field. Available methods and analyses for predicting the average power input into a simple structure in frequency bands are reviewed. In the discussion of equivalence between turbulent-field (actual) and sound-field (simulated) excitation, it is concluded that simulation is possible if required power levels in the various frequency regions can be supplied by the sound field. The problems associated with the spectral simulation of a turbulent field with a sound field are also discussed. It is shown that the acoustically measured spectrum is about 25 times as broad as the exciting spectrum for the hydrodynamically fast mode. In the case of hydrodynamically coincident modal response, an empirical estimate of spectral broadening must be made. E.P.V.

N65-15394 National U. of Ireland, Dublin.
LINEAR BOUNDARY-VALUE PROBLEMS III. THE λ-METHOD FOR POLYGONAL PLATES
Patrick M. Quinlan Apr. 1964 26 p refs
(Grant AF-EOAR-62-43)
(SR-1; AD-603734)

Edge functions and the λ-method for providing a particular integral—or Green's function—are combined to formulate the necessary simultaneous equations governing the bending of a polygonal plate, with or without polygonal holes, under a wide range of loadings and boundary conditions. In particular, the computer-formula approach is developed, under which all cases are combined in a single formula complete with the necessary computer indicators. D.E.W.

N65-15414 California Inst. of Tech., Pasadena.
STUDIES ON THE PROPAGATION OF ELASTIC WAVES IN SOLID MEDIA
Charles Kenneth Grimes (Ph.D. Thesis) 1964 74 p refs Sponsored by AF
(AD-423220)

Stress and displacement correction terms resulting from application of a subsonically moving point load to the free surface of the infinite half-space are obtained using Fourier transform techniques. It is shown, for the supersonically traveling point load, that the solution is given, in the limit as the load velocity becomes large, by the well-known solution of Sauter for the impulsive point load. Analytic function theory is used to predict the existence of Rayleigh waves on the free surface of the infinite half-space and of Stoneley waves along the welded interface between two dissimilar solid media. The early and long-time approximations for the hoop stress generated through scattering of a plane dilatational wave by a cylindrical cavity in an infinite medium are developed. Use is made of Friedlandler's Rieman surface representation (early time) and expansion in Fourier series (long time). Author

N65-15415 Johns Hopkins U., Baltimore, Md.
REPRESENTATION AND ANALYSIS OF SIGNALS. PART XVIII: VECTOR AND TENSOR ALGEBRA OF SIGNALS APPLIED TO SATELLITE NAVIGATION
Dan C. Ross (Ph.D. Thesis) 20 Jul. 1964 119 p refs
(Contract Nonr-4010(13))
(AD-603775)

The basic concepts of signals and linear systems are formulated in terms of finite-dimensional vector algebra. Important ideas often confused or omitted in classical signal theory, are clarified by the system of notation and nomenclature presented in the dissertation. Measurement and specification are emphasized in the notation as is appropriate to their importance in engineering practice. The theory and notation are extended to finite-dimensional tensor product spaces. The extension to multilinear systems of the engineer's intuitive knowledge of linear systems is illustrated. The abstract notions are illustrated by application to the familiar problem of time-domain multiplication. The utility of the notation and the tensor product concepts is demonstrated by application to satellite navigation signal processing. Descriptions of feasibility tests on the IBM 7094 and excerpts of results are presented. Author

N65-15417# Suffield Experimental Station, Ralston, Alberta (Canada).
EXPLANATORY NOTES ON THE CANADIAN PROJECTS IN THE 1964 500 TON TNT SUFFIELD EXPLOSIONS
G. H. S. Jones. ed. 30 Jun. 1964 52 p refs
(SUFFIELD-SP-43)

Brief details are given of the background, experimental methods, and methods of analysis involved in the surface detonation of 500 tons of TNT. Included are discussions of the following: (1) measurements of free-field overpressures, particle trajectories in the blast wave, and density in the blast wave; (2) detecting ground level asymmetry in the blast; (3) aerial photogrammetry of the shock front; (4) thermal and long-range seismic measurements; (5) study of the crater and ejecta; (6) ground failure around trenches and tunnels; and (7) detonation velocity measurements. P.V.E.

N65-15420# Canadian Armament Research and Development Establishment, Valcartier.
EDSER-BUTLER INTERFERENCE IN THE SUBSTRATE OF 2.5–5.0 MICRON BAND PASS INTERFERENCE FILTERS
W. A. Young (de Havilland Aircraft of Can.) Dec. 1964 11 p
(CARDE-TN-1624/64)

While measuring the spectral transmission characteristics of several band-pass interference filters, an intensity oscillation was observed in a portion of the pass band. This was attributed to Edser–Butler interference in the substrate material of the filter. An unusual dependence of the magnitude of the interference effect on the angular orientation of the filter was observed, and the interference may be effectively eliminated by proper orientation of the filter with respect to the incident radiation direction. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-14531*# Massachusetts Inst. of Tech., Cambridge.
COHERENTLY DRIVEN MOLECULAR VIBRATIONS AND LIGHT MODULATIONS
E. Garmire, F. Pandarese, and C. H. Townes [1963] 9 p refs Submitted for Publication
(Grant NsG-330)
(NASA-CR-58211) OTS: HC $1.00/MF $0.50

Very intense maser beams in dense matter produce higher order Raman effects through excitation of intense coherent molecular oscillations at infrared frequencies. These modulate the original light and its Raman-scattered radiation producing Stokes and anti-Stokes lines of many orders, frequently without a threshold condition for generation and in some cases with highly directional radiation patterns. Theory is developed for these Raman effects and conclusions (some of which correspond to experimental observations) are presented. E.W.

N65-14573# Maryland U., College Park. Inst. for Molecular Physics
BESSEL FUNCTIONS OF IMAGINARY ORDER AND IMAGINARY ARGUMENT
Siu-kay Luke and Stanley Weissman 12 Oct. 1964 89 p refs
(Contract DA-ARO(D)-31-124-G466)
(AROD-4251-3; AD-449709)

A table of Bessel functions whose order and argument are both purely imaginary was prepared. These Bessel functions are solutions to the Schrodinger equation in which the potential energy is an exponential function. It is found that this function represents the repulsive potential of diatomic molecules quite accurately. Author

N65-14602*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
LHK—AN IBM 7044 CODE TO CALCULATE CROSS SECTIONS AND KERNELS FOR LIQUID PARA- AND ORTHO-HYDROGEN
Y. D. Naliboff 30 Jul. 1964 18 p refs
(Contract NAS3-4214)
(NASA-CR-54227; GA-5652) OTS: HC $1.00/MF $0.50

This report describes the code LHK, which calculates double-differential cross sections, total cross sections, and kernels for liquid para- and ortho-hydrogen. The physical model and derivation of the equations are given. Section I presents the equations as they are used in the code; section II provides an overall description of the code and comments about various subroutines; section III discusses the various approximations used, their effects, and some of the checks made; section IV describes additions to the code which may be made; and section V gives the input instructions. Author

N65-14671# Iowa State U. of Science and Tech., Ames.
A COMPUTER METHOD FOR DETERMINING BY LEAST SQUARES GAMMA RAY RELATIVE INTENSITIES USING A BENT-CRYSTAL MONOCHROMATOR
Joseph Emerson Brown and E. N. Hatch Aug. 1964 74 p refs
(Contract W-7405-ENG-82)
(IS-993) OTS: $3.00

A method of measuring gamma-ray relative intensities was developed which used a germanium bent-crystal spectrometer as a monochromator. The response function of a NaI detector to the essentially monoenergetic gamma rays, obtained from the diffracted beam of the spectrometer, was recorded in a multichannel analyzer. The composite spectrum due to all the gamma rays was then recorded in the analyzer. A computer program was written to normalize the response functions to unit area and to determine, by minimizing the sum of the squares of the deviations, the linear combination of monoenergetic response functions that best represents the composite spectrum. The intensity of a gamma ray is then proportional to the adjusted area under the monoenergetic response function. The relative intensities of the gamma rays of Tm-169 obtained by electron capture from Yb-169 were measured. Author

N65-14680# California U., Livermore. Lawrence Radiation Lab.
FORTRAN PROGRAMS USEFUL IN SCATTERING EXPERIMENTS
S. F. Eccles, H. F. Lutz, and J. Stevens 19 Jun. 1964 39 p refs
(Contract W-7405-ENG-48)
(UCRL-7734) OTS: $1.00

FORTRAN programs are presented for calculating the geometrical factor which relates measured yield to differential scattering cross section in experiments using a gas target, and for calculating kinematic relationships for nonrelativistic

nuclear particle collisions. The geometrical factor for gas scattering is calculated assuming two circular apertures define the scattered particles which enter the detector. The kinematic calculation includes, among many other quantities, the energy which is deposited in a detector by the scattered particle, after it has passed through a thin ΔE detector. Both codes are written for an IBM 7094 digital computer and the Livermore Monitor system. FORTRAN listings are given for each. Author

N65-14688# Atomic Energy of Canada, Ltd., Chalk River, Ontario.
SCATTERING LAW $S(\alpha,\beta)$-VALUES FOR H_2O AT 550°K
D. I. Page Oct. 1964 21 p refs
(AECL-2093; CRRP-1196) Available from Atomic Energy of Canada, Chalk River: $0.50

Differential neutron-scattering cross sections for water have been measured at several temperatures, and the present work extends the measurements to 550° K. This report presents the experimental data in the form of the scattering law for comparison with the compilation for water at 295° and 423° K published by Haywood. Author

N65-14691# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
A SOLUBLE THREE-CHANNEL MODEL FOR DIRECT NUCLEAR REACTIONS [UN MODELLO RISOLUBILE A TRE CANALI PER REAZIONI NUCLEARI DIRETTE]
L. Indorato and G. Papini 25 Jul. 1964 21 p refs
(ISS-64/31)

A field theoretical model is presented that is suitable for the description of direct nuclear reactions. A method is given for solving the model exactly and for constructing offshell transition amplitudes and relations among them. Some simple approximations are also derived. Author

N65-14692# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
ON THE EMISSION OF NEUTRONS FROM THE FISSION FRAGMENTS [SULL'EMISSIONE DI NEUTRONI DA PARTE DEI FRAMMENTI DI FISSIONE]
G. Matthiae 8 Sep. 1964 10 p refs *In* ITALIAN; ENGLISH summary
(ISS-64/35)

The statistical model of the nuclear reactions was applied to the spontaneous fission of Cf^{252}. The number of neutrons emitted from each fragment is calculated in function of the fragment mass. The resulting distribution which is in good agreement with the experimental data reporduces the discontinuity observed at A = 125. This discontinuity is correlated with the decrease of the nuclear level density at the neutron magic number 82. Author

N65-14693# Maryland U., College Park.
NUCLEAR MODELS AND THE OSMIUM ISOTOPES
Amand Faessler (Freiburg U.), Walter Greiner, and Raymond K. Sheline (Florida State U.) Nov. 1963 13 p refs
(Contracts AT(40-1)-2434; Nonr-1797(00))
(TR-338)

Compared are the energies obtained for the ground state bands, in the three even mass nuclei Os^{188}, Os^{188}, and Os^{190}, using the Rotation Vibration model, and using the model of Davydov with the rotation vibration interaction of the beta vibrations taken into careful consideration. The comparisons indicated that the RV-model had several advantages relative to the Davydov model. Excellent agreement was obtained between experiment results and theory. P.V.E.

N65-14699# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD JANUARY-APRIL, 1964 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO-APRILE 1964]
26 May 1964 60 p *In* ENGLISH and ITALIAN
(ISS-64/18)

CONTENTS:

1. STRUCTURE AND FUNCTION OF DNA OF POLYOMA VIRUS R. Dulbecco (Salk Inst. for Biol. Studies) p 1–2
2. EXPERIMENTS ON MESONIC ATOMS G. Backenstoss (CERN) p 2–3
3. GENERAL PROPERTIES OF SUPERFLUID HELIUM G. Careri (Rome U.) p 3–5
4. MOST RECENT RESEARCH DEVELOPMENTS IN THE FIELD OF COSMIC RADIATION C. Castagnoli (Turin U.) p 5–6
5. MOLECULAR ARCHITECTURE OF S-RNA G. L. Cantoni (Natl. Inst. of Mental Health, Bethesda, Md.) p 6–9
6. ANTIPROTON-PROTON CROSS SECTIONS BETWEEN 0.6 AND 5 GeV/c U. Amaldi, Jr. p 9–13
7. INTRODUCTION TO THE STUDY OF REGGE POLES IN RELATIVISTIC THEORY L. Sertorio (Rome U.) p 13–21
8. SOME PROBLEMS ON THE MORPHOGENESIS OF PHAGE PARTICLES E. Kellenberger (Geneva U.) p 21–24
9. FERROELECTRICS E. Fatuzzo (RCA Labs., Ltd., Zürich) p 24–28
10. A NEW CLASS OF ANTIBIOTICS A. Vaciago and G. Tecce (Rome U.) p 28–35
11. STATE CONTROLS G. Cortellessa p 35–36
12. THE PAIRING-FORCE HAMILTONIAN AND SOME OF ITS EXACT EIGENSTATES N. Sherman (Michigan U.) p 36–40
13. NUCLEAR SIZE MEASUREMENTS FROM COHERENT π^0 PHOTOPRODUCTION S. Penner (NBS, Washington, D.C.) p 40–45
14. STUDIES ON THE "IN VITRO" SYNTHESIS OF POLIPEPTIDES M. S. Bretscher (Med. Res. Council, Cambridge) p 45–47
15. REPLICATION OF SMALL COLIPHAGES: ϕ X 174, M 12, M 13 P. H. Hofschneider (Max-Planck-Inst. für Biochem. München) p 47–49
16. ANTIVIRAL CHEMOTHERAPY B. Babudieri p 49–51
17. THE RELATION BETWEEN DNA SYNTHESIS AND CHROMOSOME TRANSFER DURING BACTERIAL CONJUGATION J. D. Gross (Inst. de Biol. Moleculaire, Geneva) p 51–54

N65-14715# Maryland U., College Park.
ROTATION VIBRATION INTERACTION IN DEFORMED NUCLEI
Walter Greiner, Amand Faessler, and Raymond K. Sheline (Florida State U.) Dec. 1963 42 p refs
(Contract Nonr-1797(00); AT(40-1)-2434)
(TR-345)

Presented is a table of the diagonalized rotation–vibration theory in a form that is independent of the special parameters characterizing the individual nucleus. The table gives the energies for different spins (up to I = 120) and bands in units of

ϵ (moment of inertia) as a function of the γ-vibrational energy and of the β-vibrational energy. A brief description of the collective Hamiltonian of the rotation–vibration theory is presented, and the basic functions and classification of the basic states are discussed. Classification of the diagonalized states is also discussed, and their matrix elements are given. Some of the more important multipole operators in the collective coordinates are calculated and listed, and the reduced matrix elements between the different bands under consideration are presented. P.V.E.

N65-14722# Birmingham U. (Gt. Brit.)
PROPERTIES AND REACTIVITY OF GAS PHASE FREE RADICALS AND DEVELOPMENT OF MOLECULAR BEAM REACTOR Annual Report, 1 Mar. 1963–29 Feb. 1964
[1964] 41 p refs
(Contract DA-91-591-EUC-2851)
(AD-450864)

Efforts to improve a device for producing a high-energy molecular beam to study reactive bimolecular collisions are continuing and several modifications to the original apparatus are suggested. For absolute measurement of the fast neutral beam intensity, an instrument is being developed to determine the secondary electron emission from an electropolished brass plate when struck by a fast atom beam. Fast beam intensity can then be calculated from the secondary electron emission coefficient. To observe the beam from the molecular beam source, an electron multiplier, which should increase sensitivity by 10^6, is being incorporated into the mass spectrometer detector. Other factors governing performance, such as beam measurements and energy distribution, are also analyzed. Investigations of atomic oxygen produced in an rf discharge are also underway, using a mass spectrometer, a gauge, and a thermocouple for the analyses; however, preliminary results have not been correlated. M.G.J.

N65-14750# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF NUCLEAR RADIATION ON MATERIALS
21 Sep. 1964 44 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Fiz. Mat. (Moscow), 1962 p 34–57, 362–365
(FTD-MT-64-267; AD-606787)

CONTENTS:

1. INFLUENCE OF NEUTRON IRRADIATION ON PROPERTIES OF STRUCTURAL MATERIALS N. F. Pravdyuk, A. D. Amayev, P. A. Platonov, V. N. Kuznetsov, and V. M. Golyanov p 1–34 refs (See N65-14751 05-24)

2. LUMINESCENCE OF CRYSTAL QUARTZ SUBJECTED TO THE ACTION OF ULTRAVIOLET AND X-RAYS S. V. Starodubtsev and Sh. A. Vakhidov p 35–40 refs (See N65-14752 05-24)

N65-14751 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF NEUTRON IRRADIATION ON PROPERTIES OF STRUCTURAL MATERIALS
N. F. Pravdyuk, A. D. Amayev, P. A. Platonov, V. N. Kuznetsov, and V. M. Golyanov *In its* The Effect of Nucl. Radiation on Mater. 21 Sep. 1964 p 1–34 refs (See N65-14750 05-24)

Discussed are results obtained from experiments involving the influence of irradiation on the mechanical properties of reactor materials, and the influence of irradiation on the microstructure of metals and alloys. Materials studied included low-carbon steels, low-alloy steels, zirconium alloys, niobium alloys, boron alloys, and austenitic stainless steels. Conclusions reached include: (1) The amount of change in the mechanical properties depends on the conditions of irradiation (temperature and integral neutron flux). (2) Irradiation at temperatures above 400° C causes almost no change in the mechanical properties of structural materials. (3) In materials intended for the manufacture of reactor housings operating at comparatively low temperatures, the basic criteria of usefulness of the material are the degree of viscosity, and the critical temperature of brittleness. P.V.E.

N65-14752 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUMINESCENCE OF CRYSTAL QUARTZ SUBJECTED TO THE ACTION OF ULTRAVIOLET AND X-RAYS
S. V. Starodubtsev and Sh. A. Vakhidov *In its* The Effect of Nucl. Radiation on Mater. 21 Sep. 1964 p 35–40 refs (See N65-14750 05-24)

Discussed are experiments performed in studying the nature of the centers in luminescent crystals that are responsible for coloring of crystals after the appearance of different maxima of thermoluminiscence. In particular, the possibility that long-wave radiation might release the energy of the centers inducing γ-rays was studied. Irradiation of the tested samples was obtained from a γ-source, Co^{60}, with a radiation power of 600 R/sec. It is concluded that the processes of thermoluminescence of crystal quartz subjected to ionizing radiation are connected with electron transitions between different local states. The following explanation of the process of thermoluminescence is presented: During gradual heating of the γ-irradiated samples to 100° C, the electrons localized in the shallow levels of capture shift to a conducting band, where they can pass to a valence band, radiating excess energy in the form of light quanta. P.V.E.

N65-14787# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
CALCULATION OF THE K* VECTOR MESON PARAMETERS FROM ONE- AND TWO-PARTICLE EXCHANGE FORCES
J. L. Gervais (Ecole Polytechnique, Paris) Dec. 1964 44 p refs
(TH-76)

Previous calculations of the K* parameters based on the approximation of Zachariasen and Zemach (1) are improved by taking into account two-particle exchange forces using a method already proposed for the ρ-bootstrap. The forces due to K–π and π–π exchange are added to the ρ and K^{ϕ} forces considered in (1). Self-consistent solutions are obtained both in the one-channel problem (Kπ scattering with elastic unitarity) and in a two-channel problem involving the Kπ and Kη states. Contrary to the one-particle exchange forces, the forces obtained are really strong enough to generate the K*. Consequently, the numerical results show a much better agreement with experiment. Assuming that Sakurai's universality holds for the ρ-coupling, a one parameter family of solutions is obtained. The coupling constants (K*Kπ), (K*Kη), ($\rho\pi\pi$) are calculated for several values of m^2_{K*}. The first two show a good order of magnitude while the third one comes out in agreement with experiment. Author

N65-14818# California U., Berkeley. Lawrence Radiation Lab.
RECENT DEVELOPMENTS IN THE THEORY OF WEAK INTERACTIONS (LECTURE NOTES I THROUGH VII)

Nicola Cabibbo 17 Mar. 1964 96 p
(Contract W-7405-ENG-48)
(UCRL-11344) OTS: $3.00

Notes taken at a series of lectures are presented. The emphasis of the lectures was on physical concepts, since they were intended for experimentalists. Subjects covered are the A-V theory—its experimental basis; conserved vector current theory; neutrino reactions; lepton processes; Coldberger and Treiman relations—quasi conserved currents; universality and SU_3 symmetry; and nonleptonic decays. D.E.W.

N65-14857# Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
GAMMA FLUXES FROM CIRCULAR AND SPHERICAL SOURCES
Johnnie R. Keith and Frank H. Shelton 15 May 1964 27 p refs
(KN-691-64-5)

The direct (unscattered) delayed gamma fluxes from uniform disks and spheres of radioactive debris are considered for several configurations, and are compared with the flux from a point source of comparable magnitude. An approximation is also made of the buildup factor necessary to obtain the actual gamma flux from the direct gamma flux. Formulas are given for estimating the flux from (1) a point source of monoenergetic gamma rays in which the scattering and possible effects from an inhomogeneous atmosphere are not considered; (2) a plane uniform disk from the vertical symmetry axis and off-axis configuration; and (3) the delayed gammas emitted by fission products at one second after the fission process. All curves show that proximity to a disk containing 1 KT/km^2 of debris is necessary to receive fluxes much greater than 10^3 r/sec, while the dosage rate approaches infinity at the surface. However, if the disk is assumed to be a few kilometers thick, the maximum dosage rate obtainable from a fission density of 1 KT/km^2 is approximately 10^4 r/sec. M.G.J.

N65-14858# Brookhaven National Lab., Upton, N.Y. Sigma Center
NEUTRON CROSS SECTIONS. VOLUME I: Z = 1 TO 20
John R. Stehn, Murrey D. Goldberg, Benjamin A. Magurno, and Renate Wiener-Chasman May 1964 261 p refs 2d ed., suppl. 2
(BNL-325) OTS: $2.50

Measurements of neutron cross sections including thermal cross sections, resonance parameters, and cross section curves are compiled for each of the many elements or isotopes mentioned. This supplement also includes all experimental data which can influence the choice of recommended values, and references are given so that the original work can be located if needed. M.G.J.

N65-14873# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
DISTRIBUTION OF MOMENTA OF THE PROTON IN THE DEUTERON CALCULATED BY A MONTECARLO METHOD [DISTRIBUZIONE DEI MOMENTI DEL PROTONE NEL DEUTERIO CALCOLATA CON IL METODO DI MONTECARLO]
G. Farchi and A. Reale 20 Jun. 1964 19 p refs *In* ITALIAN; ENGLISH summary
(ISS-64/24)

According to the results of a paper by Goldstein and Salpeter, the solutions of the nonrelativistic Schrödinger equation for the deuteron are examined in momentum space for some static spherical potentials in coordinate space. By a Monte Carlo method 10000 momenta are extracted at random, according to a convenient proton momentum distribution. Some information is also given concerning the momentum distribution of nucleons in light nuclei. For the random extraction of the momenta a program has been written in FORTRAN IV for the IBM 7040 computer. Author

N65-14890 Joint Publications Research Service, Washington, D.C.
THE CALCULATION OF THE DOSE-STREAM DISTRIBUTION OF CAPTURE GAMMA-RAYS
L. P. Bokacheva, K. K. Polkov, and L. N. Tabolina *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 141–147 refs (See N65-14876 05-33) OTS: $3.50

A simplified method of calculating special energy distribution of dose streams of capture γ-rays is described. Graphs of the dose-stream distribution of capture γ-rays from iron, nickel, chromium, and water are given. Author

N65-14932*# Maryland U., College Park.
INTERMEDIATE STATE THEORY OF SCATTERING RESONANCES Technical Report No. 418
L. Garside and W. MacDonald Oct. 1964 18 p refs
(Grant NsG-642; Contract AT(40-1)-2098)
(NASA-CR-60101) OTS: HC $1.00/MF $0.50

Considerations presented are based on the shell model reaction theory. Calculations for the $d_{3/2}$ resonance in the elastic scattering of neutrons on O^{16} are presented. This resonance was observed at 0.934 MeV with a width of 90 keV. It is concluded that the $d_{3/2}$ resonance can be incorporated into the shell model by introducing a $d_{3/2}$ bound state, which is treated the same as other bound single-particle states. It is shown that narrow, single-particle resonances are easily treated by introducing a bound state which plays the role of an intermediate state in a Breit–Wigner resonance amplitude. The resonance energy and the width of the state are determined by a one-body effective interaction which is not resonant. E.E.B.

N65-14957*# Stanford Research Inst., Menlo Park, Calif.
THEORETICAL RESEARCH—ELECTRONIC, IONIC, AND ATOMIC IMPACT PHENOMENA Quarterly Progress Report No. 9, 16 Sep.–15 Dec. 1964
Felix Smith 15 Dec. 1964 4p
(Contract NASr-49(07); SRI Proj. PAU-4070)
(NASA-CR-60146) OTS: HC $1.00/MF $0.50

Calculations on the elastic scattering of helium ion by helium in the rainbow angle region show a great deal of fine structure oscillations. When these are averaged over the experimental distribution in angle, excellent agreement with the experimental results is found. Various changes in the potential curves used to represent the interaction show that the calculation is sensitive to change in the potential over a considerable range of internuclear distances. Cross-section curves in the region where they can be compared with the experiment appear to be sensitive to changes in the potential in the entire range from 0.2A to 5.0A. For best results, a single smooth analytical potential over the entire range is important. M.G.J.

N65-14968# Atomic Energy Commission Research Establishment, Riso (Denmark).
ELASTIC SCATTERING AS A RELATIVISTIC DOPPLER EFFECT
J. Olsen Aug. 1964 12 p ref
(RISO-82; AD-450648)

It is demonstrated how the frequency of a Compton-scattered gamma ray and the velocity of a scattered particle can

be calculated by means of the relativistic formula for the doppler effect where the doppler velocity is the velocity of the scatterer after the collision. Similarly it is demonstrated that, as viewed from the scatterer, the incoming energy is equal to the outgoing energy. It is shown that the statement that the total phase is invariant under a scattering process leads to the conservation laws of energy and momentum. Author

N65-15004# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
BREMRAD—A COMPUTER CODE FOR EXTERNAL AND INTERNAL BREMSSTRAHLUNG CALCULATIONS
H. H. Van Tuyl Sep. 1964 25 p refs
(Contract AT(45-1)-1350)
(HW-83784) OTS: $2.00

A FORTRAN II program for an IBM 7090 computer was developed for calculating external bremsstrahlung by the method of Bethe and Heitler as extended by Elwert, and internal bremsstrahlung by the method of Knipp and Uhlenbeck. The thick-target cross section for external bremsstrahlung from monoenergetic electrons was found to differ significantly at low energies from Wyard's approximation and from a linear approximation of bremsstrahlung intensity. Although both approximate methods have previously been used with reasonable success for calculating shielding requirements for beta emitters, much more satisfactory calculations result from Bethe–Heitler and Knipp–Uhlenbeck methods for determining the bremsstrahlung spectrum. Author

N65-15027# California U., Livermore. Lawrence Radiation Lab.
DETERMINING SCINTILLATOR RESPONSE TO PHOTONS AND NEUTRONS BY MONTE CARLO
Charles M. Ankenbrandt 30 Sep. 32 p refs
(Contract W-7405-ENG-48)
(UCRL-12150) OTS: $2.00

The Monte Carlo method is used to calculate the response of a standard L-24 scintillation detector to gamma rays and neutrons in the energy ranges 0.1 MeV $\leq$ E $\leq$ 10 MeV and 0.1 MeV $\leq$ E $\leq$ 14 MeV, respectively. The results for gamma rays are compared with an analytic approximation and also with experimental measurements of sensitivity made at three different gamma energies. Agreement is within the combined errors of the Monte Carlo prediction and the experimental results. In the Monte Carlo neutron problem, light output from the scintillator as a function of time is obtained. Also, the relative contribution to total light output from each of the possible processes for neutron interaction in the scintillator is given. Author

N65-15028# Argonne National Lab., Ill. Chemistry Div.
ANALYTIC SELF-CONSISTENT FIELD WAVE FUNCTIONS AND COMPUTED PROPERTIES FOR HOMONUCLEAR DIATOMIC MOLECULES
Arnold C. Wahl Aug. 1964 41 p refs
(Contracts W-31-109-ENG-38; DA-11-022-ORD-3119; Grant NSF GP-28)
(ANL-6931)

The analytic and computational framework on homonuclear diatomic molecules for Hartree–Fock–Roothaan calculations is presented. Several approaches to calculating the wave function are sketched, as well as methods of computing molecular properties from the wave function. The efficient organization of these calculations for existing digital computers is emphasized. Typical results obtained through the application of the programs and techniques developed are presented for the fluorine molecule. Author

N65-15044# Oak Ridge National Lab., Tenn. Analytical Chemistry Div.
14-Mev NEUTRON REACTIONS
J. E. Strain and W. J. Ross Jan. 1965 64 p refs
(Contract W-7405-ENG-26)
(ORNL-3672) OTS: $3.00

Reactions observed when pure, naturally occurring elements (Z = 1 to Z = 30) are irradiated with unmoderated 14-MeV neutrons produced by the $^{3}T(d,n)^{4}He$ reaction are listed. Cross sections are calculated where possible, and normalized standard gamma spectra are collected. These standard spectra are equivalent to the gamma radioactivity that will be produced when 1 g of the pure element is irradiated for a given length of time at a 14-MeV neutron flux of 5×10^{8} neutrons cm^{-2} sec^{-1}. If more than one radionuclide is produced, a spectral decay is presented. These spectra may be used to predict accurately the sensitivity of nondestructive spectral analysis of almost any sample. Author

N65-15054*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
NEUTRON CROSS SECTIONS FOR ALUMINUM Topical Report
G. D. Joanou and C. A. Stevens 13 Nov. 1964 69 p refs
Contract SNPC-27)
(NASA-CR-54260; GA-5884) OTS: HC $3.00/MF $0.75

The neutron cross section data presented for aluminum are based on existing experimental data, whenever possible. Gaps in the existing data were filled by theoretical calculations and in some cases by educated guesses. The compiled and evaluated data were incorporated into the GAM-II slowing-down program and into the GATHER-II thermalization program. Tables are presented for the following: (1) possible neutron reactions in aluminum in the energy range below 15 MeV; (2) resonance parameters for aluminum; (3) neutron cross sections of aluminum; (4) Legendre expansion coefficients for elastic scattering; and (5) inelastic cross sections for aluminum. R.R.D.

N65-15063# California U., Berkeley. Lawrence Radiation Lab.
MECHANISM OF HYPERFRAGMENT FORMATION IN K^- CAPTURE
J. W. Patrick and P. L. Jain 9 Nov. 1964 24 p refs
(Contract W-7405-ENG-48)
(UCRL-11328, Rev. I) OTS: $2.00

The energy spectrum of the negative pions emitted from the K^- -capture stars in association with hyperfragments can be separated into two groups, the one of lower energy being larger. On the other hand, the fact that all the π^+ mesons have energies typical of the lower-energy group confirms the assumption that the π^+ must originate in association with Σ^- hyperons. It is deduced that a majority (71%) of the Λ^0's originate in Σ-conversion processes. The frequency of π^0 emission in association with hyperfragment production is evaluated. The reactions for the production of Λ's by K^- absorption on one or two nucleons are discussed. Attempts to separate K^- captures in C, N, or O from those in Ag or Br are almost completely successful. It is estimated that less than 20% of the multinucleon absorption occurred in heavy elements. Author

N65-15066# California U., Livermore. Lawrence Radiation Lab.
ON THE ACCURACY OF DIFFUSION THEORY FOR NEUTRON MODERATION

J. R. Terrall Aug. 1964 28 p refs
(Contract W-7405-ENG-48)
(UCRL-12128) OTS: $2.00

As the diffusion theory is less complicated than the more accurate transport theory, it has been extensively developed for multiple collision problems. However if the particle mean free path approaches the "size" of the medium, or if particle absorption is large, accuracy may be questionable. Corrections, which would bring the diffusion theory closer to a true transport theory, have been investigated, using the linear Boltzmann equation with arbitrary scattering kernels (inelastic as well as elastic.) With all angular detail in scattering included, a self-contained equation was derived for the angle-integrated particle flux, in which a transport operator appears, rather than a diffusion coefficient depending on the cross sections for particles of a given energy. The procedure developed is one of successive approximations, using the diffusion-theory form of transport theory at each step. M.G.J.

N65-15067# California U., Livermore. Lawrence Radiation Lab.
ON THE CALCULATION OF A COLLISION DISTANCE WHEN CONDITIONS ALONG THE PATH ARE CONTINUALLY HANGING
J. R. Terrall 5 Nov. 1964 11 p
(Contract W-7405-ENG-48)
(UCRL-12170) OTS: $1.00

In Monte Carlo calculations for transport problems, it is necessary to know how far individual particles are likely to travel between collisions. This is a simple calculation if the collision cross sections do not change as a particle moves through a medium. However, if the cross sections are changing because of density variations or because the particles comprising the medium may themselves have velocities which cannot be ignored, the calculation may become quite involved. A simple method and several variations on it are presented. Author

N65-15100# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
WEAK-INTERMEDIATE BOSONS AND UNITARY SYMMETRY
B. d'Espagnat [1964] 8 p refs Presented at the Roy. Soc. Discussion meeting, 5 Nov. 1964

Two questions are considered, one of experimental evidence for the actual existence of intermediate bosons, and the other of their connection with unitary symmetry. Current-current theories of weak interactions are discussed in two classes, according to the way in which they account for the nonleptonic $\Delta I = 1/2$ rule. A comparison of one such theory with the octet enhancement theories is given, and the possibilities of intermediate bosons as "trions" and of PC violation are briefly discussed. D.E.W.

N65-15109# American Science and Engineering, Inc., Cambridge, Mass.
THE FLUORESCENCE OF AIR AND NITROGEN EXCITED BY 50 KEV ELECTRONS Final Report, 15 Feb. 1961–31 Jan. 1964
Gilbert Davidson and Robert O'Neil May 1964 64 p refs
(Contract AF 19(604)-8035)
(ASE-512; AFCRL-64-466; AD-608058)

An electron bombardment system was constructed using the technique of differentially pumped chambers. A monoenergetic beam of electrons with energy up to 60 keV and current up to 5 mA can be obtained operating into a target chamber at 1 atmosphere of air or nitrogen. The relative integrated intensities of the various spectral components observed from air and nitrogen at pressures of 5, 200, and 600 torr when bombarded by 50 keV electrons are reported. The spectral region 3200Å to 10,800Å was analyzed. The observation of several previously unobserved bands and lines of nitrogen is reported. Author

N65-15196# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
NON BARYONIC RESONANCES
F. Demay, W. Vernon (Princeton U.), and A. L. L. Videira [1963] 40 p refs *Its* Notas de Fisica, Vol. 10, No. 18

Production modes of pion decay and some of the characteristics for the ρ, ω, and η resonances are presented in tables. Included are data on a number of new "bumps" and the P' and ABC resonances. A short survey of the theoretical considerations that lead to the discovery of the pion resonances is presented. The properties of nonresonant states with quantum numbers B = 0, S = 0, obtained in strong interactions, are summarized and presented in two parts, one listing the well established isobars, and the other, the possible new resonant states. G.G.

N65-15201 Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
GAMMA-RAY SPECTROMETRY OF NEUTRON-DEFICIENT ISOTOPES Annual Progress Report
R. L. Heath and J. E. Cline AEC Natl. Reactor Testing Station, Nov. 1964 58 p refs
(Contract AT(10-1)-205)
(IDO-17050) OTS: $3.00

The objective of this program is to produce a set of pulse-height spectra representing the response of a standard gamma-ray scintillation spectrometer to radiations emitted in the decay of neutron-deficient nuclides. Work has included the production of over 200 neutron-deficient isotopes by gamma-ray and proton-induced reactions on a linear electron accelerator and a cyclotron. Spectra of over 40 individual isotopes are presented in final form. The results of preliminary investigations of the application of lithium-ion drifted germanium semiconductor detectors to gamma-ray spectrometry are also presented. Emphasis during this fiscal year has been on the investigation of short-lived isotopes. Using a fast pneumatic shuttle system, nuclides with half-lives of less than one second have been observed. Author

N65-15206 California U., Berkeley.
NON-DIPOLAR INTERACTION BETWEEN NEAREST NEIGHBOR NEODYMIUM IONS IN THE ETHYL SULFATE
J. M. Baker Aug. 1964 19 p refs Submitted for Publication
(Contract Nonr-222(61))
(TR-12; AD-604090)

Measurements made on the epr spectrum of a pair of interacting nearest neighbor neodymium ions in lanthanum ethyl sulphate show that the interaction is predominantly dipolar, but that there is an additional term.

$$A_{ij}S_{iz}S_{jz} = 1/2\, B_{ij}(S_{i+}S_{j-} + S_{i-}S_{j+})$$

with

$$A_{ij} = +32 \pm 6 \times 10^{-4}\text{cm}^{-1}$$

and

$$B_{ij} = -3 \pm 3 \times 10^{-4}\text{cm}^{-1}.$$

A semiquantitative discussion is given of the possible origins of this nondipolar contribution including superexchange, electric quadrupole–quadrupole, and virtual phonon exchange interactions. Author

N65-15237# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
SPIN RELAXATION OF ATOMIC HYROGEN IN CaF_2: EVIDENCE FOR LOCAL MODES Scientific Report No. 3
D. W. Feldman and J. G. Castle, Jr. 15 Jul. 1964 22 p refs (Contract AF 19(628)-3838)
(AFCRL-64-645; AD-609298)

The spin-lattice relaxation time, T_1, of atomic hydrogen in calcium fluoride has been measured at 3 kOe and at temperatures from 2.1° to 165° K. The values of T_1 can be expressed by

$$1/T_1 = BT + C(T/\Theta)^7 J_6(\Theta/T) + D_H \exp(-T_H/T)$$

where $B = 0.028\ \text{sec}^{-1}\text{°K}^{-1}$, $C = 2.7 \times 10^4\ \text{sec}^{-1}$, and $D = 9 \times 10^6\ \text{sec}^{-1}$. The characteristic temperatures are $\Theta = 474°$ K and $T_H = 850 \pm 60°$ K. Similar measurements have been made on atomic deuterium centers. The relaxation data for deuterium centers can be accurately fitted by an expression of the above form where there is an additional term due to cross relaxation; where B, C, and Θ have the same values; and where $D_D = 8 \times 10^5\ \text{sec}^{-1}$ and $T_D = 640 \pm 80°$ K. The characteristic temperatures of 850° K and 640° K are interpreted in terms of local modes which involve the motion of the interstitial hydrogen and deuterium atoms with respect to neighboring fluorines. The basis for this identification is discussed in terms of Feynman diagrams. Author

N65-15254# California U., Berkeley. Lawrence Radiation Lab.
HIGH-ENERGY PARTICLE DATA. VOLUME I: KINEMATICS OF PARTICLES AS A FUNCTION OF KINETIC ENERGY
W. Peter Trower, Beverly Hill Willis, and Charles V. Stableford Jan. 1965 128 p refs Rev.
(Contract W-7405-ENG-48)
(UCRL-2426, Vol. I) OTS: $4.00

Kinematics of elementary particles—electrons, leptons, mesons, protons, hypersons, deuterons, and alpha particles—are graphically depicted, as are the dynamics of collisions with a proton target—photons, electrons, mesons, and hyperons. The kinematic quantities are displayed as a function of particle kinetic energy for the most common elementary particles; the dynamic quantities are presented as a function of incident particle energy for these elementary particles interacting with a photon. Also included are articles dealing with an ellipse-plotting method for solving the relativistic two-body problem, a mnemonic device for relativistic kinematic formulas, some rules for relativistic kinematics, and the calculation of a solid angle subtended by a finite rectangular counter. M.G.J.

N65-15255# California U., Berkeley. Lawrence Radiation Lab.
HIGH-ENERGY PARTICLE DATA. VOLUME III: KINEMATICS OF PARTICLES AS A FUNCTION OF MOMENTUM
W. Peter Trower Jan. 1965 117 p ref Rev.
(Contract W-7405-ENG-48)
(UCRL-2426, Vol. III) OTS: $4.00

The kinematic quantities as functions of particle momentum are developed for the most common elementary particles, and the dynamic quantities are presented as functions of incident-particle momentum for the most common elementary particles interacting with a proton. An ellipse-plotting method is described that gives a useful graphic solution for the relativistic two-body problem. Graphs of the kinematics of various elementary particles, and also of the dynamics of collisions with a proton target are presented. G.G.

N65-15264# Kongelige Danske Videnskabernes Selskab, Copenhagen (Denmark).
COULOMB EXCITATION IN DEFORMED NUCLEI
Hans Lutken and Aage Winther 1964 34 p refs *Its* Matematisk-fysiske Skrifter, Vol. 2, No. 6

In multiple Coulomb excitations of deformed nuclei a weak excitation of rotational bands, which are associated with states of different intrinsic structure, is observed. The excitation amplitudes of such states have been computed in the approximation, with the energy differences between the states of a rotational band neglected. For the case of dipole, quadrupole and octupole excitations the results are given in tabular form. They show that the relative population of the states within a band depends strongly on the spin and K quantum numbers, as well as on admixtures in the wave function of components from the ground-state band. A detailed investigation of the dependence of the cross sections on scattering angle is presented. Appreciable deviations from the so-called $\chi(\theta)$-approximation are found, especially concerning the excitation of the unnatural parity states. Author

N65-15267# European Atomic Energy Community, Brussels (Belgium).
RESULTS OF THE RADIOACTIVITY MEASUREMENTS IN THE COMMUNITY COUNTRIES
1964 111 p In GERMAN, FRENCH, ITALIAN, DUTCH; ENGLISH summary
(EUR-1820 d, f, i, n) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 160 Belg. Fr.

CONTENTS:

1. MEAN MONTHLY VALUE OF THE RADIOACTIVITY IN GROUND LEVEL ATMOSPHERE p 19–35
2. MEASUREMENT DATA OF THE RADIOELEMENTS CONTAINED IN SUSPENDED ATMOSPHERIC PARTICLES p 36–46
3. MONTHLY DATA OF THE RADIOACTIVITY IN ALL COLLECTED PRECIPITATIONS p 47–70
4. MONTHLY DATA OF THE RADIOELEMENTS IN ALL COLLECTED PRECIPITATIONS p 72–96
5. DATA OF THE RADIOACTIVITY IN SURFACE WATER p 97–116

N65-15315# Tufts U., Medford, Mass.
MICROWAVE PRESSURE BROADENING. SUDDEN PERTURBATION APPROXIMATION
Carl O. Trindle and Karl H. Illinger 30 Sep. 1964 15 p refs (Contract Nonr-494(19))
(AD-607572) OTS: $1.00

A search for the quantitative characterization of molecular interaction in relation to pressure broadening is described. An attempt is made to simplify the theoretical complication of breakdown of the adiabatic approximation theory. An assessment is made of the minimum separation, the potential energy function, and the statistics of the collisions, as a guide to the improvement of the physical model. The areas of discussion covered are the intensity function, the sudden perturbation approximation, the statistics of collisions, and some numerical calculations. R.E.S.

N65-15384# Nihon U., Tokyo (Japan). Coll. of Science and Engineering
DOMINANCE THEOREM IN CROSSING MATRICES AND ITS PHYSICAL IMPLICATIONS IN HIGH ENERGY DIFFRACTION SCATTERING THEORY

Naohiko Masuda [1964] 23 p refs
(NUP-64-18)

The following theorem is proved in SU(2) and SU(3) groups. The absolute magnitude of the nonzero crossing matrix element between s-channel amplitude in the singlet state and t- or u-channel amplitude in a given arbitrary multiplet state is never smaller than the absolute magnitude of the crossing matrix element between s-channel amplitude in an arbitrary multiplet state and t- or u-channel amplitude in a given arbitrary multiplet state. The possible implications of this theorem in the high energy scattering are discussed. Author

N65-15418# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE ORIGIN OF CERTAIN THREE-PARTICLE RESONANCES
P. Dennery and A. Krzywicki Dec. 1964 7 p refs
(TH-77)

Using a formalism which describes the interaction between a stable and an unstable particle, a mechanism leading to a three-particle resonance is discussed. After presentation of the formalism, a simplified case with a reduced number of parameters is discussed. Conclusions are as follows: (1) By applying multichannel theory with factorization assumption, the three-particle resonance may appear as a result of a strong, attractive interaction between particle a and the tail of combined particles (bc) (2) Two conditions are necessary to have a resonance above threshold. (3) Branching ratios are generally similar providing there is a resonance of particles (bc). (4) Weight may be taken proportionally to the cross section for the reaction $b + c \rightarrow b + c$. (5) The simplest form of the theory may correspond to the A_1-resonance. R.E.S.

N65-15422# European Atomic Energy Community, Brussels (Belgium).
THE CONCEPT OF "NEUTRON IMPORTANCE" IN REACTOR PHYSICS
W. Matthes 1964 35 p refs
(EUR-1897.f) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 50 Belg. Fr

Statistical theories for fluctuations in neutron fields which were developed in the past start mainly from the forward Chapmann–Kolmogoroff equation, and the studies of second or backward Chapmann–Kolmogoroff equation are included. The interaction between a neutron source and a neutron detecting instrument via a neutron transmitting medium is investigated. The instrument is taken in a general sense to include measurements of reaction rates and coincidence rates. The total measured effect in the instrument is the sum of all the effects of the individual source neutrons. The effect of a source neutron starting at $[P_0 t_0]$ on the instrument is called the importance $I(P_0 t_0)$ of the neutron. A general theory for this importance function is developed starting from the Kolmogoroff equations describing the random walk of the neutron distribution. It turns out that the backward equation is the equation for the importance field, i.e., the adjoint Boltzmann equation in the simple case of reaction rate measurements and the equation for the coincidence rate in correlation measurements. The equations of the importance for the last two cases are evaluated explicitly and a physical interpretation of their solution is given. Author

N65-15423# Argonne National Lab., Ill. Reactor Physics Div.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, OAK RIDGE NATIONAL LABORATORY, OCTOBER 13–14, 1964
A. B. Smith [1964] 134 p refs
(WASH-1053) OTS: $4.00

Informal statements of recent developments, changes of emphasis, and preliminary data of importance to the cross-section measurement program of the AEC were presented. Among the subjects discussed were general experimental physics, nuclear theory, fission physics, pile neutron physics, nuclear structure, slow neutron and resonance physics, scattering law measurements, neutron cross sections with bomb sources, fast neutron and charged particle physics, gamma-ray cross section and angular distribution, photonuclear physics, gamma-ray spectroscopy, charged particle physics, and nuclear reaction studies. M.G.J.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-14477# Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
ANALYTICAL-EXPERIMENTAL CORRELATION OF RADIATION LOSS FROM AN ARGON ARCJET
Martin P. Sherman, Paul F. Jacobs, and Jerry Grey Wright-Patterson AFB, Ohio, ARL, Aug. 1964 43 p refs
(Contract AF 33(657)-9962)
(ARL-64-132; AD-609722) OTS: $1.25

A previous report described a series of total radiation surveys of a turbulent argon arc jet using a collimated radiation probe. The results, although based on admittedly "rough" experiments, indicated a total radiation loss considerably less than prior theoretical predictions. In the present report, these theories are reviewed in some detail, and the entire series of experiments is reexamined, particularly with reference to the effect of collimation on the results. It was found that although the radiation distributions measured previously were accurate, the method used to analyze the data was incorrect. Using the same experimental data, the measured radiation loss was recalculated properly, taking into account the effect of the collimator. Results indicated a considerably larger loss than had been reported, and were found to agree quite well with the theoretical estimates given in the present report. Author

N65-14478# Minnesota U., Minneapolis. Heat Transfer Lab.
THERMODYNAMIC PROPERTIES OF CARBON-NITROGEN MIXTURES AT HIGH TEMPERATURES Interim Technical Report
Kwang-tien Shih, Warren E. Ibele, Edgar R. F. Winter, and Ernst R. G. Eckert Wright-Patterson AFB, Ohio, ARL, Sep. 1964 133 p refs
(Contract AF 33(657)-7380)
(ARL-64-149; AD-609670)

For the system carbon (graphite) and nitrogen, equilibrium composition and thermodynamic properties were calculated using spectroscopic data. Enthalpy, constant pressure heat capacity (frozen and equilibrium), entropy, and compressibility values are tabulated over the temperature range 1000° to 15 000° K and pressure range from 10^{-3} to 100 atm. Enthalpy-composition charts were prepared for the same regions. Author

N65-14565*# National Aeronautics and Space Administration, Washington, D.C.

COHERENT OSCILLATIONS IN A HIGH-VOLTAGE PENNING DISCHARGE [KOGERENTNYYE KOLEBANIYA V VYSOKOVOL'TNOM RAZRYADE PENNINGA]

M. G. Kaganskiy, D. L. Kaminskiy, and A. N. Klyucharev Nov. 1964 14 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 6, 1964 p 1050–1056

(NASA-TT-F-9222) OTS: HC $1.00/MF $0.50

In a high voltage Penning cold-cathode discharge in argon at a pressure of (0.5 to 4)·10^{-3} mm Hg and in a magnetic field ranging from 1000 to 3000 Oe, regular discharge current oscillations are developed whose frequency (10 to 100 kc) is directly proportional to the anode voltage and inversely proportional to the magnetic field. The oscillation amplitude of the discharge current is comparable to its mean value. The possible mechanism of such oscillations is discussed. Author

N65-14570# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

DIRECT DETERMINATION OF TRANSITION TO TURBULENCE DURING REENTRY

A. E. Fuhs 12 Oct. 1964 56 p refs

(Contract AF 04(695)-269)

(TDR-269(4810-21)-1; SSD-TDR-64-134; AD-452989)

Experiments conducted with an arc jet demonstrate that turbulent fluctuations can be sensed. A steady magnetic field interacts with the turbulent flow of electrically conducting gases to generate fluctuating currents. The magnetic field associated with the currents is sensed by a coil. An experiment to determine in flight the transition to turbulent flow has been incorporated in a blunt nose reentry vehicle. Coils provide an applied magnetic field. One sensing coil has a diameter equal to the predicted laminar boundary thickness just prior to transition, and the other coil is approximately twice the size. When the flow is laminar, U is steady, and no signal should occur. Transition to turbulence causes U to become a function of time, and an emf appears at the terminals of the sensing coil. A sharp rise in signal level indicates transition. Author

N65-14575# California U., Berkeley. Electronics Research Lab.

DYNAMIC PINCH PUMPING SOURCE

I. Gorog 29 Mar. 1964 45 p refs *Its* Rept.-64-7

(Contract DA-ARO(D)-31-124-G317; Grant AF-AFOSR-117-63)

(AROD-3323-4; AD-448491)

The potentials of a magnetically compressed plasma as a high intensity light source are investigated. The physical arrangement is that of a dynamic pinch. The motion of the confined plasma column is studied both experimentally and theoretically throughout a wide range of parameters. It is found that the peak intensity of the emitted light in the 2000 to 6000 Å spectral region is maximum when the plasma reaches minimum radius at times comparable to the quarter cycle period of the discharge current. When the parameters are adjusted to give this mode of operation, a single high-intensity light pulse, lasting approximately 2 × 10^{-6} sec, is emitted. The peak intensity is found to be maximum with xenon as the filling gas. The absolute intensity of the light emitted from helium, air, argon, and xenon plasmas is measured. The results indicate that a dynamic pinch arrangement can be employed in order to obtain peak intensities significantly in excess of those available from conventional flash lamps. Author

N65-14589# Princeton U., N.J. Plasma Physics Lab.

THE HEATING OF A PLASMA AND THE GENERATION OF ION WAVES BY MEANS OF MAGNETIC PUMPING

John M. Dawson and Myron F. Uman Aug. 1964 36 p refs

(Contract AT(30-1)-1238)

(MATT-294)

This paper discusses heating of a cylindrical plasma by the application of an oscillating magnetic field. Two theories are developed. One, which is applicable at low temperatures and high densities when the collision rate is high compared with the pumping frequency, is a fluid theory. Both linear and nonlinear numerical calculations are carried out. The second, which is applicable at high temperatures, treats the ions by means of a Vlasov equation, whereas the electrons are treated as a fluid in equilibrium. In the latter theory, the effect of the electric field is included. When the mean free path of the ions is less than the length of the pumping region the fluid theory is used; when it is greater than the length of the pumping region, the collisionless theory is used. Heating rates calculated from the two theories are in essential agreement when the mean free path is comparable to the length of the pumping section. Author

N65-14590 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

SHOCK PRODUCED PLASMA RESPONSE TO MICROWAVE IRRADIATION

G. W. Bethke and A. D. Ruess Nov. 1963 61 p refs

(Contract AF 30(602)-1968)

(R63SD91; AD-424404)

At elevated microwave power levels incident on a shock front, the deposition of rf energy causes nonequilibrium ionization enhancement in the vicinity of (rf) critical electron density located in the thermally ionizing region near the shock front. Subsequently this ionization "shield" grows toward the shock front while its peak electron density increases to several times the critical density. As this happens, the microwave reflection coefficient of the plasma increases, shielding the main body of plasma from the microwave field. Probably due to an electron density-dependent ionization mechanism, this rf-induced plasma shield continues to grow in electron density as that section of plasma is swept back from the shock front away from the microwave interaction region or if the rf power is turned off. If the rf power is great enough, the above microwave-induced plasma shield appears to break away from the shock front and rapidly propagate on ahead towards the rf source at several times the shock velocity. Author

N65-14593# Unified Science Associates, Inc., Pasadena, Calif.

STABLE DENSE COLD PLASMA Semiannual Technical Summary Report, Period Ending 19 Aug. 1964

S. Naiditch [1964] 37 p refs

(Contract Nonr-3437(00); ARPA Order 194

(AD-449522)

The major efforts have been directed toward validating an electrodeless Hall measurement technique, measuring densities of liquid sodium ammonia solutions from −60° to +60° C, studying the conductivities of $Na\text{-}NH_3$ solutions, and improving solution preparation techniques to enable increasing lifetimes at elevated temperatures or attaining higher temperatures. Author

N65-14601 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF AN MGD POWER GENERATION DUCT Summary Report
Frederick H. Shair 15 Jan. 1965 95 p refs
(Contract NAS3-4103)
(NASA-CR-54124) OTS: HC $3.00/MF $0.75

An electron beam and externally applied electric fields were used to increase the plasma electrical conductivity (above the neutral particle temperature Saha equilibrium value) in an MGD generator while maintaining a gas static temperature ~1500° K; the static pressure was ~ 1 1/2 atm. Preliminary experiments were conducted in pure argon, in argon seeded with cesium, and in argon seeded with mercury (metastable mixture). Electron densities were monitored at two positions (on either side of the magnetic field) by means of a 60-KMC microwave interferometer. The duct cross section was uniform at 1 cm X 3 cm. Author

N65-14608*# National Aeronautics and Space Administration, Washington, D.C.
EXCITATION OF OSCILLATIONS BY AN ELECTRON BEAM IN A PLASMA [VOZBUZHDENIYE KOLEBANIY ELEKTRONNYM PUCHKOM V PLAZME]
I. F. Kharchenko, Ya. B. Faynberg, E. A. Kornilov, and N. S. Pedenko Dec. 1964 13 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 6, 1964 p 1031–1036
(NASA-TT-F-9221) OTS: HC $1.00/MF $0.50

The development of instability during interaction of an initially uniform (unmodulated) primary electron beam with a plasma in a magnetic field has been investigated experimentally. The conditions for onset of instability and the spectrum of the excited particles were determined. The experimentally observed instability is found to be consistent with the theoretically predicted instabilities in the interaction of an electron beam in a plasma waveguide situated in a magnetic field. It was demonstrated experimentally that because of acceleration of the plasma electrons in high frequency fields an additional ionization occurs as instability develops, and the plasma density attains values several orders of magnitude larger than the density of the electron beam. Author

N65-14611*# Consultants and Designers, Inc., Arlington, Va.
A MAGNETIC TRAP VERSION [VARIANT MAGNITNOY LOVUSHKI]
S. P. Lomnev 7 Dec. 1964 8 p refs Transl. into ENGLISH from Fiz., Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 4, 1964 p 827–830
(Contract NAS5-3760)
(NASA-TT-F-9606; ST-PF-10255) OTS: HC $1.00/MF $0.50

The use of a magnetic dipole field for the retention and accumulation of hot plasma was investigated. The motion of hydrogen ions in a magnetic dipole field was considered for temperatures near those used for obtaining thermonuclear reactions. From an analysis of the results, the following conclusions were reached: (1) Losses of particles of one sign (ions) begin at densities of the order of 10^{11} p/cm^3, and take place at the center on dipole conductors, as well as on the chamber walls in the equatorial region. (2) The mean value of the radius of the volume occupied by particles rises with time. (3) The use of a complementary magnetic field notably decreases the rise of the mean radius. (4) The energy spectrum of particles washes out in time; and the particles from the distribution tails vanish, either by hitting the walls of the chamber in the case of high velocity particles, or by hitting in the center on the dipole as in the case of low velocity particles. D.S.G.

N65-14614*# Consultants and Designers, Inc., Arlington, Va.
PAIR COLLISIONS OF METASTABLE HELIUM ATOMS IN THE PLASMA [PARNYYE STOLKNOVENIYA METASTABIL'NYKH ATOMOV GELIYA V PLAZME]
P. L. Pakhomov and I. Ia. Fugol' 21 Dec. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 159, no. 1, 1964 p 57–59
(Contract NAS5-3760)
(NASA-TT-F-9613; ST-NP-PP-10262) OTS: HC $1.00/MF $0.50

The afterglow observed during a few milliseconds in a helium plasma after the discharge has ceased is understood to be the result of the presence of long-lived atoms in the metastable state 2^3S. Generally speaking, in the absence of admixtures, the breakdown of this state is determined by the following processes: (1) diffusion of metastable atoms toward the walls; (2) collisions of the excited atoms with two atoms in normal state; and (3) pair-collisions of metastable atoms with one another. Process (3) is interpreted according to the scheme

$$He(2^3S) + He(2^3S) \rightarrow He_2^+ + e.$$

After a study of the mechanism and the rates of the process, and the establishment of the dependence of the pair-collision processes of metastable atoms on gas pressure, it was concluded that the helium atom in normal state participates in the process. The scheme of the process is thus represented by

$$He(2^3S) + He(2^3S) + He(1^1S) \rightarrow He_2^+ + e + He(1^1S).$$

D.S.G.

N65-14625*# Minnesota U., Minneapolis. Heat Transfer Lab.
THE THERMAL ANALYSIS OF ANODE AND CATHODE REGIMES IN AN ELECTRIC ARC COLUMN Quarterly Progress Report No. 6, Oct. 1–Dec. 31, 1964
E. Pfender, S. A. Wutske, K. T. Shih, T. Eddy, and E. R. G. Eckert 15 Jan. 1965 24 p refs
(Contract NAS3-2595)
(NASA-CR-54120) OTS: HC $1.00/MF $0.50

The heat-transfer phenomena in an electrical arc tunnel containing argon were studied by using both a single, plane, segmented anode, and a double, nonsegmented anode arrangement. Arc voltage oscillograms and high-speed movies were taken of the arc when operating with both the segmented and nonsegmented anodes. The total current in the arc of the segmented anode was essentially constant with respect to time, but all traces contained a small amount of stray pickup. Measurements of the average field strength provided several sets of data for various gap distances. Measurements of the voltage required to restrike the arc were not successful because of the fast breakdown of the discharge. High-speed movies of the double anode configuration showed the existence of a steady arc mode and a fluctuating arc mode. The nonuniform flow appeared to be connected with the asymmetry of the inlet to the test section. Also described is a spectrometric system for plasma measurements in arc tunnel. G.G.

N65-14659*# Space Technology Labs., Inc., Redondo Beach, Calif.
NEUTRALIZATION AND INTERACTION PHENOMENA IN A LOW-DENSITY ION EXHAUST
J. M. Sellen, Jr. [1963] 29 p refs Presented at the Thirteenth Gen. AGARD Assembly, Athens, 5–17 Jul. 1963
(NASA-CR-51415) OTS: HC $2.00/MF $0.50

The observed interaction phenomena in the low-density plasma beams of the electrostatic thrust engines are discussed. The interaction of the electrons in the plasma with the electric field structure in the column, and the electron–magnetic field interaction are reviewed. Further phenomena which are considered include the electron–atom and electron–ion interactions, and the generation of oscillations in the plasma column at the plasma frequency from the two-electron stream instability. The use of the plasma stream for plasma-vehicle studies in a "plasma wind tunnel" is described. Author

N65-14663# Princeton U., N.J. Plasma Physics Lab.
BEHAVIOR OF NEUTRAL HYDROGEN AND HELIUM IN C STELLARATOR DISCHARGES
F. W. Hofmann, A. S. Bishop, and E. Hinnov Sep. 1964 24 p refs
(Contract AT(30-1)-1238)
(MATT-305)

Time-resolved brightness scans of H_2 and H_α light, and of He I and He II light, were made across the plasma column of the C-stellarator during ohmic heating discharges in hydrogen and helium, respectively. These scans were converted to radial distributions of the light emission by Abel's integral equation. The results are interpreted in terms of the relative importance of the competing processes of ionization by electron impact and of charge exchange. It is concluded that a substantial fraction of the inflowing H atoms enter the discharge with energies less than 0.3 eV, i.e., significantly below the most probable energy, 2 eV, of the dissociation products of H_2 or H_2^+. The helium atoms enter the discharge at or near room temperature. Author

N65-14667# Vitro Labs., West Orange, N.J.
ION DEBRIS SIMULATION Quarterly Progress Report, 1 Apr.–30 Jun. 1964
[1964] 27 p refs
(Contract DA-30-069-ORD-3616)
(VL-2267-12-0; AD-450946)

Impact experiments for determining the properties of plasma debris showed macroscopic damage to silicon and lucite targets. Examination of silicon pieces indicated apparent thermal etching, nonuniform surface interactions, and local melting and flowing. The lucite target showed signs of surface decomposition, apparently generated by local thermal gradients. A 500-joule energy storage system was used for impacting. High-speed photographic analyses, which illustrate the text and formulas for characterizing the impact phenomena, are given. The problem of spallation damage to solids by plasma impact and calculations for the plasma parameters necessary to generate shock waves of sufficient amplitude for spallation are also examined. M.G.J.

N65-14682# Michigan U., Ann Arbor. Electron Physics Lab.
ANALYSIS OF CROSSED-FIELD SPACE-CHARGE FLOWS Technical Report No. 74
Nino A. Masnari (Ph.D. Thesis) Jul. 1964 319 p refs
(Contract AF 33(615)-1553)
(Rept.-06349-2-1; AD-603515)

This paper investigates the characteristics of space-charge flows in crossed dc electric and magnetic fields. The investigations include theoretical considerations of rectilinear laminar space-charge flow, analog and digital computer analyses of electron injection systems, and experimental studies of beam characteristics. In general the results provide a better understanding of the operation of injected-beam crossed-field devices. Author

N65-14714# Princeton U., N.J. Plasma Physics Lab.
RESISTIVE OVERSTABILITIES AND ANOMALOUS "DIFFUSION"
Francis F. Chen Oct. 1964 32 p refs
(Contract AT(30-1)-1238)
(MATT-306)

A physical picture is given of microinstabilities which can occur in plasmas of finite resistivity with or without an effective gravitational field, and of finite Larmor radius stabilization. The drift waves become overstable because of a phase shift between the density and potential fluctuations. Transport of plasma across a magnetic field also arises from this phase shift; this transport does not necessarily resemble a diffusion process. This mechanism may account for the anomalous diffusion commonly observed in fully ionized plasmas. Particular attention is paid to the real part of the frequency and to the phase correlations, which can easily be measured to test this hypothesis. In regard to stellarator "pumpout", it is found that increasing the conductivity will not reduce the part of the loss rate which is due to the "universal" resistive overstability. Author

N65-14784# Princeton U., N.J. Plasma Physics Lab.
THE EFFECT OF WEAK COLLISION ON ION WAVES
R. Kulsrud and C. S. Shen Oct. 1964, 28 p refs
(Contract AT(30-1)-1238; Grant NSF GP-579)
(MATT-302)

The linearized Fokker–Planck equation is solved by an iteration method which assumes the collision term is one order higher than the other terms. It is solved for the case of ion wave instabilities, where the unperturbed situation consists of a constant electric field, electrons with the Spitzer–Härm distribution, and ions with a Maxwellian distribution of much lower temperature. The effect of collisions on the critical current for instability is determined, and it is found that the electron ion collisions predominate and lower the critical current. The linearized Fokker–Planck equation is also solved for the case of ion waves in a cesium plasma. Here the electrons are taken as an isothermal fluid. The propagation and space damping constants obtained from the first root of the dispersion relation are determined for the situation where the ions have a large mass velocity relative to laboratory frame of reference. Author

N65-14817# California U., Livermore. Lawrence Radiation Lab.
CONTROLLED THERMONUCLEAR RESEARCH Semiannual Report, Jan.–Jun., 1964
R. F. Post et al [1964] 145 p refs
(Contract W-7405-ENG-48)
(UCRL-12028) OTS: $4.00

Research on controlled thermonuclear processes shows the following progress: (1) The superposition of various multipole transverse fields suppresses the dominant gross instability in the confinement of a plasma in a simple mirror field. (2) Diagnostic equipment has been installed to study single-pulse injection, trapping, and confinement, and several experiments are being prepared and calibrated. (3) A fine-scale instability in the Levitron operation has been identified as due to pulsed dc current flowing along the lines of force. By substituting rf heating at about 5 Mc/sec frequency, the plasma is stably confined for duration of the pulse. (4) The resistive instability tearing mode has been demonstrated in the tubular pinch, with the cylindrical plasma column observed to break up into 12 evenly spaced shreds. Calculations from a computer program, using the parameters of this experiment, agree with experimental results. (5) Computation of hydromagnetic

equilibria in minimum-B systems with finite plasma pressure has been carried out for two symmetrical configurations—the stuffed cups and the Andreoletti–Furth disc geometry. M.G.J.

N65-14830# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
EXTENSION OF THE M^2- AND THE THIN-WING EXPANSION METHODS TO MAGNETOHYDRODYNAMICS
Kinzo Hida (Cincinnati U.) Nov. 1964 27 p refs
(Contract AF 33(616)--8453)
(ARL-64-176; AD-609568)

On the basis of a reduced equation for steady, two-dimensional flow of a perfectly conducting gas with an alined magnetic field, the, M^2-expansion method, as well as the thin-wing-expansion method, is extended to include the effect of a magnetic field. General formulas obtained by both methods remain unchanged, except that the parameters involved are redefined. The transonic thin-airfoil theory is also modified for magnetohydrodynamic flow, and it is found that the same similarity rule for the flow past a slender body holds for both nonmagnetic and magnetic cases with the proper alteration of the parameters. Author

N65-14949*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A GEOMETRICAL REPRESENTATION FOR THE HIGH FREQUENCY DIELECTRIC TENSOR OF A TEMPERATE PLASMA
Sidney Brooks Washington, NASA, Jan. 1965 7 p refs
(NASA-TM-X-1054) OTS: HC $1.00/MF $0.50

A new geometrical representation for the high-frequency dielectric tensor of a temperate plasma is given. It is simple in form and readily shows the effect of varying the plasma parameters. Author

N65-14998# New Mexico State U., University Park. Research Center
AN EXPERIMENTAL STUDY OF RADIO FREQUENCY PLASMOIDS Annual Technical Report No. 1
H. B. Williams, August Miller, and J. Robert Trimmier Oct. 1964 14 p refs
(Contract Nonr-3531(03)
(AD-607790)

The experimental program consists of three distinct approaches. The first is to probe the plasmoids with a silver ion beam, i.e., the measurement of beam deflection as a function of position in order to determine the average charge number density of the plasmoid. The unexpected disappearance of the ion beam within the plasmoid has, however, altered the problem. The second approach is to utilize metallic Langmuir probes and the double probe in order to ellicit much the same information as the ion beam probe. The present effort here is directed toward the establishment of probe characteristics within this type of discharge. A spectroscopic investigation of the plasmoids is also being conducted in order to obtain a kinetic temperature profile of the discharge region. Author

N65-15058*# Consultants and Designers, Inc., Arlington, Va.
ON THE CONSTRUCTION OF A MAGNETOHYDRODYNAMIC MODEL OF A CYCLONE [O POSTROYENII MAGNITOGIDRODINAMICHESKOY MODELI TSIKLONA]
A. G. Khantadze 21 Jan. 1964 10 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 6, 1964 p 1020–1025
(Contract NAS5-3760)
(NASA-TT-F-9629; ST-AM-10279) OTS: HC $1.00/MF $0.50

A type of rotating, ideal, compressible, conducting fluid which includes, in each horizontal plane, a rotation with an angular velocity around a shifting center is described. Specific conditions which must be satisfied are listed and analyzed. Formulas for motions at any given moment and for lines of current are developed. The solution found gives the desired motion (considered as the magnetodynamic model of a cyclone or anticyclone) in a strongly conducting atmosphere, with the hydrodynamic motion changing the magnetic field, particularly for the ionosphere and the solar atmosphere. Omitting the magnetic field the solution found coincides with that of Kochin. R.E.S.

N65-15061*# National Aeronautics and Space Administration, Washington, D.C.
THE INTERACTION OF CHARGED PARTICLES WITH A TURBULENT PLASMA [O VZAIMODEYSTVII ZARYAZHENNYKH CHASTITS S TURBULENTNOY PLAZMOY]
I. A. Akhiyezer Jan. 1965 19 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 47, no. 8, 1964 p 667–677
(NASA-TT-F-9233) OTS: HC $1.00/MF $0.50

The interaction between charged particles and a plasma consisting of cold ions and hot electrons moving relative to the ions with a velocity exceeding that of double-temperature sound is investigated. The rate of energy and momentum change due to emission and absorption of turbulent sound oscillations is determined. It is shown that the details of the turbulency spectrum do not affect the dependence of the indicated quantities on particle velocity or direction of motion. The level of turbulent fluctuations determines only the overall coefficient in the expressions for energy and momentum transfer. Interaction between charged particles and turbulent oscillations of other types is also considered, e.g., high frequency electron or short wave ion oscillations. Author

N65-15095 California Inst. of Tech., Pasadena.
THEORY OF PLASMA WAVE RESONANCES IN A HOT NONUNIFORM PLASMA
Jerald V. Parker Jun. 1964 80 p refs
(Contract Nonr-220(50))
(TR-23; AD-603534)

This work is concerned with the resonant motion exhibited by a plasma column which is excited by an oscillating electric field transverse to the column. A theory is considered which includes the effects of electron temperature and of nonuniformities in the plasma electron density. The theory yields a fourth order differential equation which is integrated numerically to find the predicted resonant frequencies. The predictions are compared with experiment and show excellent agreement. It is concluded that the nonuniform electron density plays a crucial role in determining the resonant frequencies. The effect of an axial magnetic field upon the resonances was investigated. The field causes each resonance to split into a right and left circularly polarized resonance whose frequencies depend on the field strength. Author

N65-15117# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE STEADY STATE OF IONIZATION IN WEAKLY IONIZED PLASMA IN THE NON-EQUILIBRIUM STATE

E. Matsuura Dec. 1964 15 p refs Transl. into ENGLISH from Denki Shikensho Tho (Tokyo), v. 27, no. 7, 1963 p 491–495
(RSIC-333; AD-609439)

The problem of generalization of the Saha formula is discussed in terms of inelastic scattering, multiple ionization process, secondary effects due to spin or wall effects, relationship of inelastic collision process with ionization and recombination, and an assumption that neutral atoms possess one energy value. Derivation of a generalized formula includes three-body collision of particles and radiating and absorbing electromagnetic radiation. The problem of the stationary state of ions appears to be the basic concern in a generalization formula. The Dewan equation is used as an example of an attempt at generalization. As a result of treating a simplified model formula, the temperature of the electron is found to be greater than that of the neutral atom; the ionization density increases. In this idealized condition, the collision frequency in electrical conductivity is determined by elastic scattering; the stationary-state ionization plasma is treated as increasing the electrical conductivity. R.E.S.

N65-15123# Stanford U., Calif. Microwave Lab.
A STUDY OF THE PLASMA BOUNDARY
R. S. Harp Wright-Patterson AFB, Ohio, ARL, Oct. 1964 131 p refs
(Contract AF 33(616)-8121)
(ARL-64-138; AD-609567)

The basic experimental technique was to pass an electron beam through the sheath parallel to the wall and, by measuring the deflection of the beam, transverse dc and rf electric fields in the sheath were measured. Measurements of the dc fields are compared with a theory based on a solution of the complete plasma-sheath equation. By means of this comparison it is possible to accurately evaluate the plasma parameters n_e and T_e. It is concluded that the static and dynamic properties of the sheath are adequately described by theory, and that the resonance probe can be a useful and accurate device for plasma diagnostic measurements. Author

N65-15141*# Pennsylvania U., Philadelphia. Inst. for Direct Energy Conversion
EMITTER SHEATH POLARITY IN PLASMA DIODES
Goerge L. Schrenk [1964] 9 p refs Presented at the Thermionic Specialists Conf., Cleveland, 26–28 Oct. 1964
(Grant NsG-316)
(NASA-CR-60197) OTS: HC $1.00/MF $0.50

A phenomenological macroscopic model was used to investigate the criteria for determining the sign (polarity) of the emitter sheath in a broad-spaced plasma diode. The ratio of electron emission current to ion emission current does not uniquely determine the emitter sheath sign. The net volume ionization and/or recombination and the electron plasma temperature are also important. No specific mechanism for volume ionization is assumed; both the net volume ionization and the electron temperature are treated as unknown parameters. Some numerical results obtained from this model are presented. Author

N65-15154*# National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTION TO THE THEORY OF RESONANT IONIZATION PROBES [ETUDE THEORIQUE DES SONDES D'IONISATION A RESONANCE]
G. Trapp Jan. 1965 23 p refs Transl. into ENGLISH of Tech. Note CDS 26, Centre Natl. D'etudes des Telecommun., 20 Aug. 1964
(NASA-TT-F-8752) OTS: HC $1.00/MF $0.50

This report examines the current furnished by a probe immerged in a plasma. After a general discussion of the response curve, the calculation of the approximate resonance frequency of the plasma is explained and it is shown that the width of the maximum is (within certain approximations) proportional to the frequency of the plasma. The conclusion examines the validity of these approximations and suggests more realistic starting assumptions. Author

N65-15165# Nagoya U. (Japan). Inst. of Plasma Physics
TABLES FOR MICROWAVE REFLECTION COEFFICIENTS FROM AN INHOMOGENEOUS PLASMA COLUMN IN A RECTANGULAR WAVEGUIDE
Hideo Ikegami and Akizi Outi Aug. 1964 349 p
(IPPJ-29)

The numerical calculation of the reflection coefficients is performed on the electronic computer IPP OKITAC-5090. As the results, amplitudes $|R|$ and arguments θ of the reflection coefficients, as well as the voltage standing wave ratio, are tabulated for such parameters as (ω_0^2/ω^2), ν/ω, $k\rho$, and ka. The advantage of the microwave reflection method is that the probing microwave frequency is not limited by the electron plasma frequency and that the method is still effective in a longitudinal magnetic field present. The use of the tables makes it possible to determine the electron density on the axis of the plasma column and the effective collision frequency of electrons with a known plasma radius $k\rho$ and the waveguide dimension ka. Author

N65-15180# General Motors Corp., Indianapolis, Ind. Allison Div.
ALLISON RESEARCH AND ENGINEERING, VOLUME NO. 4 FOURTH QUARTER 1964
[1964] 27 p refs

CONTENTS:

1. ELECTRON BEAM WELDING–APPLICATIONS AND DESIGN CONSIDERATIONS FOR AIRCRAFT TURBINE ENGINE GEARS N. F. Bratkovich, W. L. McIntire, and R. E. Purdy p 2–9 (See N65-15181 05-15)

2. OPERATION AND DIAGNOSTICS OF A CLOSED LOOP MPD POWER GENERATOR R. T. Schneider and H. E. Wilhelm p 10–22 refs (See N65-15182 05-25)

N65-15182 General Motors Corp., Indianapolis, Ind. Allison Div.
OPERATION AND DIAGNOSTICS OF A CLOSED LOOP MPD POWER GENERATOR
Richard T. Schneider and Horst E. Wilhelm *In its* Allison Res. and Eng., Vol. No. 4, Fourth Quarter 1964 [1964] p 10–22 refs Sponsored by ARPA (See N65-15180 05-25)

A closed loop MPD power generator system, test action, direct readout unit and heater are described. The working fluid is helium, seeded with cesium. The test section was designed specifically for diagnostic investigation of plasma properties. Results are given of test runs with pure helium, MPD simulation, and cesium runs with a variable magnetic field and a variable load resistor. Spectroscopic techniques used to measure gas temperature, electron temperature, electron density, seeding ratio, impurities, and recombination coefficient in the temperature range between 1000° and 3000° K are described. R.L.K.

N65-15233# Minnesota U., Minneapolis. Heat Transfer Lab.
THERMAL CHARACTERISTICS OF A HIGH AND LOW MASS FLUX ARGON PLASMA JET
C. J. Cremers and E. Pfender Wright-Patterson AFB, Ohio. ARL Nov. 1964 66 p refs
(Contract AF 33(657)-7380)

The thermal characteristics are determined by the plasma jets emanating from the F40 plasma torch. A grating spectrometer was used to determine the temperature fields of high and low mass flux jets generated by a 400 A arc. The temperature distributions in a cross section close to the nozzle were determined as well for a number of other mass flows at a 400 A current input. Also, similar distributions were obtained for the high and low mass flux cases at 600 A. A calorimeter was used to measure the energy output of the torch for various mass flows. Additionally the radiation from the torch was measured with a radiometer. The steadiness of the turbulent high mass flux jet and the meaning of the measured temperatures are discussed in detail. Author

N65-15235# Aerojet-General Nucleonics, San Ramon, Calif.
INDUCTIVE PLASMA ACCELERATION RESEARCH Final Report, Jul. 1963–Jun. 1964
D. C. Gates, L. J. Demeter, W. B. Day, and J. L. Wyatt Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 150 p refs
(Contract AF33(657)-10979)
(AN-1238; APL-TDR-64-97; AD-609728)

To evaluate the use of distributed charge exchange in a transmission-line type of inductive plasma accelerator, it is necessary to measure the flux and angular and energy distribution of the ions and neutrals that are accelerated and expelled from the transmission line. The emphasis of the program was on the provision of a diagnostic system capable of rapidly performing the required measurements. The diagnostic systems in two main parts, the detector section (for use in study of the transmission line), and the calibration section. The design, construction, testing, and calibration of both the detector and the calibration section are described. Author

N65-15291# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
RADIATION FROM AN ELECTRIC DIPOLE IN A PLASMA COLUMN Scientific Report No. 4
S. R. Seshadri 7 Aug. 1964 24 p refs
(Contract AF 19(628)-2410)
(AFCRL-64-695; AD-609304)

The radiation characteristics of an axially oriented electric dipole in an isotropic plasma column are investigated. Surface waves are excited for frequencies less than $1/\sqrt{2}$ times the plasma frequency. The dependence of the the power carried by the surface, as well as the space wave, on the frequency and the radius of the plasma column is examined. The surface waves are excited with maximum efficiency in the neighborhood of 1/2 times the plasma frequency. The radiation pattern in the far zone is evaluated and has, in general, a maximum in the broadside and a null in the end-fire directions. The normalized radiation resistance varies as the square of the frequency for small column dimensions and for high frequencies. Author

N65-15348# Brown Engineering Co., Inc., Huntsville, Ala.
HEAT TRANSFER AND MICROWAVE EXPERIMENTS FOR A PLASMA JET FACILITY
S. K. Suh and P. F. Mc Donald Nov. 1963 29 p refs
(R-78; AD-424850)

The plasma jet facility uses arc heating to obtain a hyperthermal plasma which is discharged through a supersonic nozzle. The plasma jet discharged may have temperatures on the order of 1000° or 2000° K and velocities of about 4400 ft/sec. Particular experiments which could be conducted in the facility are described: (1) aerodynamic heat transfer studies—stagnation point heat transfer, heat transfer experiments using a calibration cone, and heat transfer to uninstrumented models; (2) plasma microwave interactions—plasma electromagnetic properties, plasma scattering of microwaves, and plasma scattering model evaluation. P.V.E.

N65-15361# Stanford U., Calif.
INTERFEROMETRIC STUDY OF THERMAL EQUILIBRATION OF A SHOCK-HEATED PLASMA. DIRECT ENERGY CONVERSION SYSTEMS, SUPPLEMENT NO. 2 Quarterly Technical Summary Report, 1 Mar.–31 May 1964
Howard Wong and Daniel Bershader 20 Apr. 1964 97 p refs
(Contract AF 49(638)-1123; ARPA Order 246)
(AD-609417)

The mechanisms for ionization induced by strong normal shock waves in argon gas were studied though the use of optical techniques, primarily the Mach–Zehnder interferometer. The optical interferometry technique was used in conjunction with a rotating mirror camera and provided a history of the mass density and electron density across the shock, through the nonequilibrium regime, and into the equilibrium region. The densities were obtained from a shift of fringes associated with the change in refractive index of the gas as the shock propagated through it. The onset of radiation was found to occur rather abruptly toward the end of the nonequilibrium region at a measured level of electron density. The measured electron densities at the shock front and in the equilibrium region were found to be in agreement with existing theory. Also, comparison of the theoretical and experimental equilibration models gave a consistent interpretation to the observed profiles and gave additional information on atomic rate parameters. R.R.D.

N65-15371*# College of William and Mary, Williamsburg, Va. Plasma Physics Lab.
MICROWAVE CAVITY MEASUREMENT OF THE FARADAY EFFECT IN A MAGNETOPLASMA
Maurice T. Raiford (M.A. Thesis) and Frederic R. Crownfield, Jr. [1963] 14 p refs Presented at the 6th Intern. Conf. on Ionization Phenomena in Gases, Orsay, France, 8–13 Jul. 1963
(Grant NsG-106-61)
(NASA-CR-51551) OTS: HC $1.00/MF $0.50

Observations were made of the coupling of the orthogonal, linearly polarized, TE_{111} modes of a right cylindrical cavity due to the Faraday effect in a coaxially located, neon glow discharge. Measurements as a function of applied magnetic field are interpreted in terms of a simple theory to yield an effective electron collision frequency. The values of the collision frequency obtained in this way are greater than predicted from the momentum-transfer collision cross section. Some data showed anomalies near harmonics of electron cyclotron resonance, but these data were not reproducible. Author

N65-15376*# Pennsylvania U., Philadelphia. Towne School of Civil and Mechanical Engineering
CRITERIA FOR EMITTER SHEATH-POLARITY IN PLASMA DIODES

George L. Schrenk [1963] 31 p refs
(Grant NsG-316)
(NASA-CR-60333) OTS: HC $2.00/MF $0.50

The general criteria used to determine the sign (polarity) of the emitter sheath in a plasma diode are examined in detail. It is shown that these general criteria reduce to those criteria presently in common use only for a collisionless plasma diode. For a broad-spaced collision dominated plasma diode, however, a phenomenological macroscopic model is used to show that the ratio of the electron emission current to the ion emission current does not uniquely determine the polarity of the emitter sheath. The net volume ionization and /or recombination and the electron plasma temperature are also shown to be important. No specific mechanism for volume ionization is assumed; both the net volume ionization and the electron temperature are treated as unknown parameters. Numerical results are presented for several cases of interest in thermionic energy conversion. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

26

N65-14498# Norwegian Defence Research Establishment, Kjeller.
ACOUSTIC RESONANCE IN PIEZOELECTRIC CRYSTALS
O. H. Longva 17 Mar. 1964 54 p refs
(Contract AF 61(052)-484)
(SR-9; AFCRL-64-945; AD-609435)

A propagating acoustic wave in a piezoelectric semiconductor suffers a damping engendered by interaction with conduction electrons. The mechanism of this damping is studied, with particular regard to its effect on acoustic resonance and thus on electric impedance. Explicit relations for electric impedance near acoustic resonance are given. Specific numerical examples for electrical impedance near longitudinal mode acoustic resonance are given for cadmium sulfide and zinc oxide. Author

N65-14500# Microwave Associates, Inc., Burlington, Mass.
RESEARCH ON MILLIMETER-WAVE GENERATION TECHNIQUES Final Report, 1 Apr. 1963–1 Apr. 1964
A. Uhlir, Jr. et al 24 Nov. 1964 98 p refs
(Contract AF 33(657)-10925)
(AFAL-TR-64-270; AD-609625)

The fabrication by an epitaxial process of multilayer semiconductor compounds of Group III-V is practical for useful heterojunction photodetector diodes. Structures of the GaAs-GaAsP material system have been designed and fabricated for high frequency efficient operation. The pin photodetector diodes have quantum efficiency of greater than 40%. The spectral response is broad, and is bounded by the absorption edge of the GaAs at low energies and by GaAsP (window layer) at high energies. The majority of the photon absorption is in the swept I-layer as concluded from photoconductive measurements, thus indicating a basic fast-conversion mechanism. An np heterojunction device consisting of n-type GaAsP deposited epitaxially on p-type GaAs results in photodetectors with a broad spectral range (500 to 8000 Å). Coherent microwave output has been obtained from bulk gallium arsenide. Fabrication techniques have been established that give near ohmic contact to 0.1 ohm-cm n-type material. Author

N65-14585# Sandia Corp., Albuquerque, N. Mex.
INTRODUCTION RATE OF ELECTRICALLY ACTIVE DEFECTS IN SILICON BY NUCLEAR RADIATION
H. J. Stein Jul. 1964 12 p refs Presented at the Special Technical Conf. on Nucl. Radiation Effects, Seattle, Jul. 1964
(SC-R-64-193)

The dependence of the hole removal rate in p-type silicon on the crystal growth method, hole concentration, and dopant impurity was investigated. Electrical conductivity measurements at 270° K as a function of fission spectrum neutron and 2-MeV electron irradiation are used to determine the removal rates. The hole removal rates are observed to increase with hole concentration as $p^{0.23}$ for neutron irradiation, and they are essentially independent of crystal growth methods and dopant impurity. The influence of the crystal growth method on the hole removal rate is increased by isochronal annealing to 100° C. The hole removal rate for electron irradiation is a more complex function of the hole concentration, and an influence of crystal growth method is observed at 270° K. Author

N65-14634# General Electric Co., Schenectady, N.Y. Research Lab.
ELECTRICAL CONDUCTANCE IN ORGANIC SOLIDS Quarterly Technical Report, 1 Apr.–30 Jun. 1964
Charles M. Huggins and Oliver H. Le Blanc, Jr. [1964] 6 p refs
(Contract DA-31-124-ARO(D)-175; ARPA Order 462)
(AD-451247)

The electrical characteristics of organic solids were studied. The work was divided into the following three areas: (1) the study of the transport of carriers injected into insulating (or poorly conducting) solids by an electron gun; (2) a series of electrical measurements on a highly conducting ion radical salt of tetracyanoquinodimethan; and (3) the study of carrier transport in some amorphous systems. Electron injection into single-crystal anthracene with a 15-keV electron beam was observed, and values were measured for the electron mobility at room temperature that were in good agreement with those previously obtained from pulsed photocurrent experiments. A voltage supply was constructed to enable operation of the gun at voltages up to 30 keV, at which voltages it is hoped to see electron-hole pair formation by the beam. Author

N65-14665# Iowa State U. of Science and Tech., Ames.
ELASTICITY AND INTERNAL FRICTION THROUGH THE KILOCYCLE RANGE: REVIEW AND ANNOTATED BIBLIOGRAPHY
M. O. Marlowe and D. R. Wilder Jun. 1964 133 p refs
(Contract W-7405-ENG-82)
(IS-925) OTS: $4.00

A review of techniques and fundamentals of Young's modulus and internal friction measurements is presented. The effect of porosity on elasticity is extensively reviewed as are factors contributing to internal friction. An annotated bibliography of 377 entries covering elasticity and internal friction measurements through the kilocycle frequency range is included and accompanied by a key word index. Author

N65-14717 Midwest Research Inst., Kansas City, Mo.
A STUDY OF THE PHYSICAL BASIS OF THE MECHANICAL PROPERTIES OF CERAMICS Technical Documentary Report, 18 Apr. 1963–15 Mar. 1964
Gordon E. Gross and Paul L. Gutshall Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 39 p refs
(Contract AF 33(657)-8572)
(ASD-TDR-63-605, Pt. II; AD-606963) OTS: $2.00

The investigation of the mechanical properties of ceramics as related to their electronic structure was continued. The optical–mechanical properties of germanium were studied, and experimental results are presented for internal friction and bending tests conducted in the presence of infrared irradiation. The cleavage energy of sodium chloride is given as a function of F-center density and testing environment. The cleavage energy of sodium chloride colored by diffusion increases by two at a density of 10^{16} F-centers/cc, with no apparent increase in the elastic modulus. Experimental results are given for Hall coefficient measurements on beryllium.

Author

N65-14727 Joint Publications Research Service, Washington, D.C.

CERTAIN PROPERTIES AND APPLICATIONS OF DIELECTRIC CRYSTALS IN WHICH THE CURRENT IS DETERMINED BY THE SPACE CHARGE

Yu. N. Fost *In its* Izv. VUZov: Radio Eng., Vol. VII, No. 4, 1964 4 Jan. 1965 p 1–17 refs (See N65-14726 05-26) OTS: $5.00

Several theoretical and experimental investigations on the properties and applications of dielectric crystals in which the current is determined by the space charge are summarized in this literature survey. Included are studies on the volt–ampere characteristics determined in insulators by the space charge, energy levels of an ideal crystal in contact with a metal electrode, crystal performance under transient conditions, and properties of cadmium sulfide crystals. Potentials for practical applications of space charge conditions in dielectrics, or in such devices as rectifiers and infrared detectors, are also discussed.

M.G.J.

N65-14760# Pennsylvania U., Philadelphia.

FERROMAGNETIC TRANSITIONS AND THE ONE-THIRD-POWER LAW

Earl Callen (Naval Ordnance Lab., White Oak, Md.) and Herbert Callen Oct. 1964 11 p refs Presented at Decennial Conf. on Magnetism and Magnetic Mater., Minneapolis, 16–19 Nov. 1964 Submitted for Publication

(Contract Nonr-551(36))

(TR-18; AD-450368)

Experiments have shown that the reduced magnetization of insulating ferromagnets varies as $m(T) = D(1-T/T_c)^f$ for $T > 0.9T_c$, and that $f = 1/3$. Calculations of magnetization for the Heisenberg model are reported which give, over a wide temperature range, both the observed exponent $f = 1/3$ and the observed coefficient D, within 2% of the experimental value. This result is obtained for a two-spin cluster theory; similar but slightly less satisfactory agreement is demonstrated by two forms of Green function theory.

Author

N65-14790# Clevite Corp., Cleveland, Ohio. Electronic Research Div.

THE STRUCTURE OF VARIOUS FERROELECTRICS: THE QUESTION OF FERRIELECTRICITY

William R. Cook, Jr. 8 Sep. 1964 68 p refs

(Contract AF 33(615)-1227)

(AFAL-TR-64-265; AD-608324)

The phase relations in the vicinity of sodium niobate and lead zirconate are reviewed, with special attention to the changes of these relations as a result of field, temperature, and pressure. It is seen that the intimate association of ferroelectricity and antiferroelectricity in these two materials gives rise to a large number of complicated phase relations. The phases present in the KH_2PO_4 structure type are also summarized, with particular attention to solid solutions.

Author

N65-14826# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.

INFRARED SPECTRA OF INORGANIC DIELECTRIC SOLIDS

Johannes N. Plendl and Peter J. Gielisse May 1964 28 p refs *Its* Phys. Sci. Res. Papers No. 59

(AFCRL-64-380; AD-608785)

The lattice vibration spectrum of a solid has recently been characterized by one single frequency, which is defined as the frequency of the center of gravity of the spectrum, called "centrofrequency." The experimental determination of this frequency is shown in detail for a number of solids, the vibrational spectra of which became available recently. Emphasis is given to spectral data at various temperatures, from 4° to about 1000° K, and at the various major crystallographic directions. The centrofrequencies at room temperature and higher temperatures show almost no change; whereas, at low temperatures the centrofrequencies consistently show a very definite increase. The result reveals a definite increase in binding energy with temperature decrease. A considerably higher resolution, particularly in the broadband areas, was obtained with spectra at very low temperatures.

Author

N65-14942# California U., Berkeley.

KNIGHT SHIFT AND NUCLEAR RELAXATION TIMES IN LIQUID GALLIUM

David Allan Cornell (Ph.D. Thesis) Jun. 1964 70 p refs

(AD-607786)

The Knight shift in pure liquid gallium is measured as a function of temperature between 300° and 740° K and obeys the empirical relation for change with temperature, $\Delta K = -(2.95 \pm 0.15) \times 10^{-7} (T - 300)$. This extends the earlier measurements of Gutowsky and McGarvey, who found qualitative agreement with free electron theory. The shift varies only slightly with volume according to the expression $K(V) = 0.00449 (V/V_0)^{-0.1 \pm 0.1}$ at pressures between 1 and 5000 kg/cm. The pressure results disagree with the free electron model, and the intrinsic temperature dependence of K, coupled with the theory of Benedek and Kushida, suggests that the s-electron probability density at the nucleus, P_F, decreases with negative curvature as a function of volume. The nuclear spin-lattice relaxation time, T_1, and spin–spin relaxation time, T_2, are measured from 270° to 470° K and $T_1 = T_2$ at 298° K to within 5%.

Author

N65-14964# California U., Berkeley.

SUBCENTIMETER WAVELENGTHS Annual Summary

M. Tinkham 1 Oct. 1964 3 p refs

(Contract Nonr-222(58))

(AD-607790) OTS: $1.00

The work of the subcentimeter wavelength group involves far infrared technique development, application of these techniques to solid-state physics problems, and additional experiments on superconductivity with techniques other than far-infrared absorption. In the area of far-infrared techniques, refinement of bolometers and amplifiers is reported. Far-infrared studies are being made on the energy gap in superconductors, magnetic resonance in ordered magnetic materials, and collision-induced absorption in gases. Work on superconductors was confined to films, whose energy gap is being measured in the presence of a magnetic field. Work on collision-induced absorption has been confined to CO_2. Work on superconductivity, not involving far-infrared measurements, was limited to the effect of a magnetic field on superconductors. The report lists the papers published during the period from October 1963 to September 1964.

E.E.B.

N65-14977# Honeywell, Hopkins, Minn. Research Center
THIN FILM IMAGE CONVERTER Sixth Interim Technical Progress Report, Jul. 24–Oct. 23, 1964
Paul W. Kruse, Fred C. Pribble, and Richard G. Schulze 20 Nov. 1964 49 p
(Contract DA-44-009-AMC-168(T))
(AD-453855)

Investigations of the epitaxial growth of n-GaAs on p-Ge have made it possible to prepare 200μ thick layers of single crystal GaAs on Ge. An evaluation of the electrical properties of samples etched to a mesa configuration, together with chemical staining studies of angle-lapped samples, reveal that an n-Ge layer is formed between the n-GaAs and p-Ge regions during the initial stages of growth. The most probable donor is As, diffused from the vapor into the Ge. Methods for preparing strong, ohmic, low resistance contacts to n-GaAs, p-GaAs, n-GaP, and p-GaP were devised utilizing ultrasonic soldering. The best techniques are summarized. Author

N65-14981# Ohio State U. Research Foundation, Columbus. Antenna Lab.
NONLINEAR INTERACTION OF LIGHT WAVES IN A DISPERSIVE DIELECTRIC
J. G. Meadors 13 Oct. 1964 30 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-15; AD-450603)

The importance of crystal orientation in the achievement of nonlinear interactions in dielectrics is discussed and demonstrated through the analysis of realistic experiments. A theory of nonlinear interactions in dispersive dielectrics is given, in which beam divergence and frequency spread in the laser fields are treated. The results of the analysis clearly specify the limitations of the plane-wave theory. Author

N65-14985# Boeing Scientific Research Labs., Seattle, Wash.
X-RAY ABSORPTION FINE STRUCTURE IN CRYSTALLINE AND NON-CRYSTALLINE MATERIALS
Farrel W. Lytle Jul. 1964 37 p refs Presented at the Intern. Conf. on Phys. of Non-Crystalline Solids, Delft, Netherlands, Jul. 1964
(DI-82-0361; AD-607766)

Analyses of extended X-ray absorption fine structure (EXAFS) in crystalline and noncrystalline solids, combined with a literature survey, suggest that EXAFS (1) can be demonstrated in all physical states, except monatomic gas; (2) are dependent upon temperature and upon the type of lattice and interatomic distance; and (3) must be geometrically suitable for inclusion of the symmetry of the original and final electron wave functions. Although high resolution was compromised for high X-ray intensity and statistical accuracy, a single-crystal spectrometer proved suitable for recording EXAFS. A block diagram of the apparatus, which includes a conventional X-ray generator, a crystal holder and positioning stage, scintillation counter, pulse height holder and electronic scaler–timer, is presented along with X-ray diffraction patterns and data analysis plots for various specimens. Although the theory developed here is phenomenological, a rather accurate accounting of the energies of absorption maxima is given. M.G.J.

N65-15029 Pennsylvania U., Philadelphia. Lab. for Research on the Structure of Matter
CLUSTER APPROXIMATION FOR FERROMAGNETS WITH FIRST AND SECOND NEIGHBOR EXCHANGE, WITH APPLICATION TO THE EUROPIUM CHALCOGENIDES
Herbert B. Callen and Earl Callen (Naval Ordnance Lab.) Jun. 1964 21 p refs
(Contract Nonr-551(36))
(TR-16; AD-602954)

The two-particle cluster approximation of Strieb, Callen, and Horwitz is extended to ferromagnets and paramagnets with nearest and next-nearest neighbor exchange, with particular reference to EuO, EuS, EuSe, and EuTe. Curie temperatures, magnetization curves for general values of the applied field, susceptibility, spin correlation functions, energy, and specific heat curves are calculated. The explore the sensitivity of the theory to the exchange constants, the results of the cluster approximation are given for various ratios of the first and second neighbor exchange constants, including the special case of vanishing second neighbor exchange (in this latter case the approximation generalizes the constant coupling approximation to arbitrary spin). It is found that all the presently measured magnetic properties are rather insensitive to the particular choice of exchange constants, provided these are chosen to be consistent with the observed Curie temperature; measurement of the spin correlation functions, however, would provide a sensitive criterion for the choice of exchange constants. Author

N65-15081# Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
ABSORPTION SPECTRA OF MATRIX ISOLATED NITROGEN TRIFLOURIDE FROM 18–50 Gc
R. L. Armstrong, J. B. Newman, and J. J. Whalen Aug. 1964 33 p refs
(Contract AF 33(615)-1051)
(WR-AF-5; AD-608739)

An experimental study was made of the absorption spectrum of NF_3 molecules trapped in an argon matrix in the microwave region from 18 to 50 Gc. A discussion of the properties of such crystals is given, followed by a description of the experimental apparatus and technique. No microwave absorption in excess of 1 dB was observed, 1 dB being the smallest signal which could be detected by the microwave spectrometer used in this experiment. Author

N65-15106# Columbia U., New York, N.Y. Columbia Radiation Lab.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Quarterly Progress Report Jun. 15-Sep. 15, 1964
R. Novick 15 Sep. 1964 87 p refs
(Contracts DA-36-039-SC-90789; Nonr-266(45); Grants NsG-360; NsG-442; AF-AFOSR-330-63 et al)
(QPR-7; AD-608160)

The discovery of the photon echo is discussed. The method of level-crossing spectroscopy has been extended to the observation of the Stark effect. A precise measurement of the Stark shift of the 3P term of lithium was completed. Additional metastable autoionizing atomic states have been observed in sodium and cesium. A systematic investigation of the Zeeman quenching of these states in all of the alkali elements was carried out using a new electron multiplier detector arrangement. A series of experiments were done to verify the predictions of Hartmann and Anderson on the effect of rf irradiation on an NMR line shape. Results give additional evidence to the hypothesis that a spin system can be described by a temperature in the rotating frame while an rf magnetic field is being applied. Author

N65-15110# Illinois U., Urbana.
THE MOSSBAUER EFFECT OF FE^{57} ON THE SURFACE OF TUNGSTEN
J. W. Burton (Ph.D. Thesis) [1964] 86 p refs
(Contract AF 49(638)-1048)
(TN-2; AD-609315)

The Mössbauer effect of Fe^{57} on the surface of polycrystalline tungsten has been measured over a temperature range of 80° to 500° K, and at angles of 0° and 60° with respect to the normal. The Mössbauer spectra consist of three unresolved lines, the middle one agreeing with measured spectra of Fe^{57} in the bulk of tungsten, and the outer two being being attributed to surface effects. The asymmetry of the surface spectra, the angular dependence of the shape, and the magnitude of the splitting of the two surface lines indicate an electric field gradient at the surface of 2.4×10^{16} V/cm^2 directed along the normal. An effective Debye temperature of 406 ± 12° K is found for the bulk, from a study of the temperature dependence of the intensity of the Mössbauer absorption. The effective Debye temperature for the surface is 354 ±30° K along the normal, and 255 ±30° K parallel to the surface.
Author

N65-15126 California U., Berkeley.
ELECTRIC QUADRUPOLE-QUADRUPOLE INTERACTION IN CERIUM ETHYL SULPHATE
J. M. Baker Aug. 1964 9 p refs Submitted for Publication
Sponsored in part by AEC and ONR
(AD-604091)

Electron paramagnetic resonance (EPR) measurements on cerium ethyl sulphate at very low temperatures show that, besides the classical dipole–dipole interaction, there is a large interaction between neighboring ions. This is attributed to electric quadrupole–quadrupole (QQ) interaction, based on the following observations: (1) the resonable size; (2) the necessity to go as low as 2° K to see EPR in the ground doublet; (3) the spectra of impurities; and (4) the EPR spectra in dilute crystals. Although incomplete parameters affect the comparisons, it appears probable that the observed interaction is a QQ interaction.
M.G.J.

N65-15128 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
ACOUSTIC AMPLIFICATION AND ELECTRON MOBILITY IN LITHIUM AND SODIUM DOPED CADIUM SULFIDE
John Allen Hubbard (M.S. Thesis) Jun. 1964 42 p refs
(GNE/PHYS/64-11; AD-603611)

Ten of the measured crystals were grown doped with lithium, sodium, or a combination of both sodium and lithium, and three crystals were grown undoped. The undoped crystals have a maximum acoustic gain of about 70 dB/cm, a Hall mobility of 170 cm^2/V-sec and a drift mobility of 160 cm^2/V-sec. The lithium-doped crystals have a maximum gain of about 100 dB/cm, a Hall mobility of 300 cm^2/V-sec and a drift mobility of 100 cm^2/V-sec. The sodium-doped crystals have a maximum gain of 3 dB/cm, a Hall mobility of 100 cm^2/V-sec, and a drift mobility of 50 cm^2/V-sec. The sodium-plus-lithium-doped crystals have a maximum gain of about 25 dB/cm, a Hall mobility of 200 cm^2/V-sec, and a drift mobility of 150 cm^2/V-sec. The measurements indicate that impurities in the crystal can either increase or reduce the acoustic amplification, and that impurities increase electron trapping within the crystal, thus reducing the drift mobility.
Author

N65-15146*# Pennsylvania U., Philadelphia.
ELECTRON EMISSION FROM METALS IN GASEOUS ENVIRONMENT
Michael Kaplit, George L. Schrenk, and Leon W. Zelby [1964] 8 p refs Presented at the Thermionic Specialists Conf., Cleveland, 26–28 Oct. 1964
(Grant NsG-316)
(NASA-CR-60178) OTS: HC $1.00/MF $0.50

A new macroscopic model of electron emission from metals in cesium environment is developed which compares favorably with other theories. This model includes the concept of the state of maximum activity and its relation to the various types of work functions. Theoretical electron emission S-curves based on this model are calculated for a cesium tungsten system, showing excellent agreement with Houston's experimental data.
Author

N65-15147*# Stanford U., Calif.
FLUX PENETRATION IN THIN WALLED SUPERCONDUCTING CYLINDERS
Roger D. Bourke Sep. 1964 16 p refs
(Grants NsG-133-61; NsG-582)
(NASA-CR-60179; SUDAER-206) OTS: HC $1.00/MF 0.50

Flux penetration into thin-walled superconducting cylinders subjected to a uniform longitudinal field is investigated. A review of past work on the subject is given, including predictions that penetration will occur at fields considerably less than critical. A detailed analysis of the field distribution is made for the geometry of interest, and an attempt is made to observe surface breakdown for cylinders of various wall thicknesses. A method for generating continuous magnetization curves and therefore observing the onset of flux penetration is described. Contrary to some past thoughts on the subject, the onset of penetration is shown to occur at values of the surface field near critical. Finally these results are discussed in relation to recent work on the cryogenic gyro.
Author

N65-15239# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
SOME RECENT ADVANCES IN MICROWAVE PHONON GENERATION AND DETECTION WITH APPLICATIONS TO THE STUDY OF PHONON-LATTICE INTERACTIONS IN DIELECTRIC MATERIALS Final Report
J. de Klerk 31 Oct. 1964 144 p refs *Its* Sci. Paper-64-9F5-108-P2
(Contract AF 19(604)-8826)
(AFCRL-64-904; AD-609479)

Some recent advances in phonon generation and detection in the gigacycle region are described. The technique, as applied to quartz, has been extended to nonpiezoelectric materials by the use of vapor deposited thin film piezoelectric transducers. Attenuation measurements in quartz, MgO, TiO_2 and Al_2O_3 are described and discussed. A theory for the behavior of attenuation as a function of temperature is also given.
Author

N65-15241# Illinois U., Urbana.
THE ROLE OF STRAIN ON THE NUCLEATION OF SOLID STATE TRANSFORMATIONS Final Report, 1 Jun. 1961–1 Sep. 1964
C. A. Wert, C. J. Altstetter, J. O. Nelson, and M. S. Rashid
1 Oct. 1964 33 p refs
(Grant DA-ARO(D)-31-124-G73)
(AROD-3172-3; AD-609017)

The allotropic transformations in iron, cobalt, cerium, and lanthanum were studied with the objective of establishing the factors which are influential in the initiation and propagation of the transformation. From a study of zone-refined iron it was concluded that interstitial solutes are not essential for the martensitic transformation of iron. The FCC⇆HCP martensitic transformation was studied in whiskers, bulk single crystals, and polycrystalline specimens of cobalt. From the measured effect of stress on the transformation it was concluded that the transformation was very defect sensitive and the habit plane was not controlled by a critical resolved shear stress criterion. In cerium, both the FCC⇆FCC and FCC⇆HCP transformations were studied in polycrystalline specimens. The FCC⇆HCP transformation in lanthanum was found to occur isothermally, in contrast to the other allotropic transformations studied in this work. Author

N65-15280# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research

STUDIES ON THE FORMATION AND PROPERTIES OF HIGH TEMPERATURE DIELECTRICS Technical Report No. 191 (Final)

A. Von Hippel et al Jul. 1964 106 p refs

(Contract AF 33(616)-8353)

(ML-TDR-64-219; AD-603899)

After theoretical discussion of basic problems, the following are summarized: methods of growing high-temperature oxide crystals, film studies in ultrahigh vacua, development of a quadrupole mass spectrograph, dielectric instrumentation and measurements from low frequencies to millimeter waves and from low temperatures to beyond 1400° C, research on ferroelectrics and on the band structure of TiC, TiN, and TiO, conduction phenomena in rutile; field gradient measurements on dielectrics, structure analysis of new high-temperature materials; chemical analysis and synthesis procedures, Mössbauer effect, and breakdown strength investigations. Author

N65-15294# Varian Associates, Palo Alto, Calif. Central Research Lab.

SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME I: MAGNESIUM GERMANIDE Interim Technical Documentary Report No. 1

H. Kroemer and W. Stein Jul. 1963 21 p refs

(Contract AF 33(657)-11015)

(Varian-307-1Q; ASD-TDR-63; AD-607986)

The preparation and study of a Mg_2Ge semiconductor to be used for nontransistor solid state electronics are discussed. The first three prepared ingots contained a large excess of Ge due to evaporation losses of Mg in a narrow-zone furnace with a central temperature of about 1350° C. It was concluded that a lower melting temperature in a long-zone furnace will eliminate some of the excess Mg losses. G.G.

N65-15364*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research

ON THE OPTICAL CONSTANTS OF METALS AT WAVELENGTHS SHORTER THAN THEIR CRITICAL WAVELENGTHS

W. R. Hunter [1963] 30 p refs Presented at the Colloq. on the Optics of Solid Thin Layers, Fac. of Sci. of Marseilles, 8–15 Sep. 1963

(NASA Order R-107)

(NASA-CR-53153) OTS: HC $2.00/MF $0.50

The optical properties of Al, In, Mg, and Si have been investigated in the extreme ultraviolet at wavelengths shorter than their critical wavelengths. It was found that Al, Mg, and Si, which have loosely bound valence electrons and tightly bound core electrons can be described, to a good approximation, by free electron theory. For In, in this spectral range, the dominant term in the complex dielectric constant is the free electron term; however, other absorption mechanisms are not negligible so a simple two-parameter theory cannot be used. Author

N65-15365*# Army Engineer Research and Development Labs., Fort Belvoir, Va.

THE OPTICAL PROPERTIES OF EVAPORATED GOLD IN THE VACUUM ULTRAVIOLET FROM 300 to 2000 Å

L. R. Canfield, G. Hass, and W. R. Hunter (NRL) [1963] 21 p refs Presented at the Colloq. on the Optics of Solid Thin Layers, Marseilles, 8–15 Sep. 1963

(NASA Order R-107)

(NASA-CR-53161) OTS: HC $1.00/MF $0.50

The reflectance and optical constants of evaporated gold films were measured in the vacuum ultraviolet from 300 to 2000 Å. The optical constants were determined from reflectance measurements made at various angles of incidence. In contrast to aluminum, gold shows little change in reflectance after deposition in vacuum and during exposure to air. Due to interference, semitransparent films of about 150 Å on glass show the highest reflectance at most wavelengths in the vacuum ultraviolet. Author

N65-15366*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research

TRANSMITTANCE OF THIN FILMS IN THE EXTREME ULTRAVIOLET

W. R. Hunter and R. Tousey [1963] 21 p refs Presented at the Colloq. on the Optics of Solid Thin Layers, Marseilles, 8–15 Sep. 1963

(NASA Order R-107)

(NASA-CR-53159) OTS: HC $1.00/MF $0.50

The extreme ultraviolet transmittance of thin unbacked films of parlodion, aluminium, and indium was measured over the wavelength range extending to 150 Å. The use of aluminum for eliminating stray light in solar spectroscopy from rockets is illustrated with solar spectra and spectroheliograms made at wavelengths near 300 Å. Author

N65-15390# Suffield Experimental Station, Ralston, Alberta (Canada).

ON SPONTANEOUS CHARGE RELEASE FROM FERROELECTRIC CERAMICS AND ITS POSSIBLE APPLICATION AS AN ELECTRONIC MEMORY

J. C. Muirhead 27 Nov. 1964 14 p refs

(Suffield-TN-55)

A review is given of previous observations on the spontaneous charge release effect, along with results of recent experiments. It is suggested that this effect, while seriously affecting the utility of some ferroelectric ceramics as blast pressure gage elements, may have application as a quantitative electronic memory. Author

N65-15393# California U., Berkeley.

DEPENDENCE OF SPIN-LATTICE RELAXATION TIME UPON MAGNETIC FIELD FOR TWO SALTS OF NEODYMIUM

J. M. Baker and N. C. Ford, Jr. Aug. 1964 23 p refs Submitted for Publication

(Contract Nonr-222(61))

(TR-15; AD-604089)

Measurements made below 1.5° K of the spin-lattice relaxation rate T_1^{-1} of Nd^{3+} in lanthanum fluoride and lanthanum magnesium nitrate as a function of the separation δ of the levels of the ground doublet give clear evidence for a dependence $T_1^{-1} \propto \delta^5 \coth(\delta/2kT)$, as expected for the direct process. There is also a second contribution at lower fields in LaF_3 $T_1^{-1} \propto \delta^3 \coth(\delta/2kT)$ arising from "forbidden" relaxation transitions in the neodymium ions which have a hyperfine structure. The relaxation rate for the forbidden transition has been calculated; under certain circumstances it can be more rapid than the relaxation rate for allowed transitions. A third contribution depends upon the concentration of Nd^{3+} and may be due to cross relaxation to coupled pairs of Nd^{3+} ions. In lanthanum magnesium nitrate there is a phonon bottleneck as well as the direct process. Both salts show an Orbach process above 2° K. Author

N65-15408# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (W. Germany).

RESEARCH ON CARBON DIOXYDE ABSORPTION CAPACITY OF A LOW-TEMPERATURE SURFACE AT TEMPERATURES FROM 68° K to 95° K [UNTERSUCHUNG DES SAUGVERMOGENS EINERTIEFGEKUHLTEN FLACHE FUR KOHLENDIOXYD BEI TEMPERATUREN VON 68° K BIS 95° K]

G. Sänger Sep. 1964 26 p refs *In* GERMAN; ENGLISH summary

(DLR-FB-64-17) Available from ZLDI, Munich: DM 7,80

Research on the carbon dioxide absorption capacity of a surface cooled to low temperatures is performed at temperatures of 68° to 95° K in the pressure region $1 \cdot 10^{-8}$ torr. In addition, the adhesion probability as a function of thermal conductivity, vaporization heat, and gas temperature is determined. For carbon dioxide and argon the determined dependence of probable adhesion agreed satisfactorily with the measurements. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-14566*# National Aeronautics and Space Administration, Washington, D. C.

A RADIAL, DIAPHRAGM-SEPARATED INJECTION METHOD FOR VARIABLE THRUST LIQUID ROCKET ENGINES WITH OR WITHOUT MIXTURE RATIO VARIATION [EINE RADIALE, MEMBRANGETRENNTE EINSPRITZMETHODE FUR FLUSSIGKEITSRAKETENTRIEBWERKE MIT VARIABLEM SCHUB UND/ODER VARIABLEM MISCHUNGSVERHALTNIS]

Lutz T. Kayser Dec. 1964 16 p Transl. into ENGLISH of a paper presented at the 15th Intern. Astronautical Congr. Warsaw, Sep. 7–12, 1964

(NASA-TT-F-9223) OTS: HC $1.00/MF $0.50

A preliminary survey is given on the development and first experimental investigations of a new injection method. It was based on theory, and it showed experimentally that very good thrust variability with constant mixture ratio and sufficient combustion stability are possible with the proposed injection system. A special configuration of a radially cavitating venturi for mass flow control was developed for the system. This configuration is also described. Author

N65-14651*# Hughes Research Labs., Malibu, Calif. Ion Propulsion Dept.

TECHNOLOGY AND DEVELOPMENT OF THE CONTACT ION ENGINE

George R. Brewer [1963] 39 p refs Presented at the Tech. Meeting of the Combustion and Propulsion Panel of AGARD, Athens, 16 Jul. 1963

(Contract NAS5-517)

(NASA-CR-51316) OTS: HC $2.00/MF $0.50

The current technology of the cesium contact ion engine is discussed. A brief introductory description of the operation of this type of electric thrustor is presented, followed by the current status and achievements of the past year or two. Some of the remaining technical problems in the development of the ion engine are discussed in some detail. These problems include the current in the accelerator electrode which can include both electron emission from this cesium covered electrode and current to the electrode from ions created by charge exchange. Results of analysis of both effects are presented. The limitation on engine life due to accel electrode erosion from charge exchange ions is shown as a function of current density and neutral efflux, and means for reduction of this effect are listed. It is shown that the neutral evaporation rate from the ionizer is an extremely important factor in determining engine life and performance. Author

28

N65-14721# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

RAMJET TECHNOLOGY: SECTION ON FLOW PROCESSES AND ENGINE PERFORMANCE. CHAPTER 2: BASIC ADIABATIC THEORY

E. A. Bunt Oct. 1964 91 p refs

(Contract NOw-62-0604-c)

(TG-670-2; AD-607979)

The adiabatic theory was applied to the case of ideal nonviscous gas flow of one-dimensional aspect, to the two-dimensional supersonic wave system, and to the thrust-producing cycle. An appendix contains tabulations of adiabatic Mach number functions. G.G

N65-14812# Institute for Defense Analyses, Washington, D.C. Research and Engineering Support Div.

THE PRELIMINARY DESIGN OF HIGH-ACCELERATION SOLID-PROPELLANT ROCKETS

Robert H. Fox Jul. 1964 64p
(ARPA SD-50)
(P-133; AD-607681) OTS: $3.00

A method was developed for simplified weight-performance calculations for high-acceleration solid-propellant rockets and included the following parameters: motor case strength and density, propellant density, burning rate law and specific impulse, burnout velocity, propulsion payload, ratio of "parasitic" weights to the structural material weight, port-to-throat diameter ratio, motor case aspect ratio, and propellant grain design. Using basic limiting equations for F, the dimensionless burning rate, and for G, the dimensionless acceleration, it was shown: (1) Design solutions do not exist for $G > 0.0938$. (2) If F is less than about 0.1, the problem is dominated by the propellant burning rate, and the attainable values of G are further reduced. (3) By rational design procedures, the weight penalty associated with high accelerations can be reduced to less than 50 percent. (4) There is a strong relationship between the ratios of motor case diameter to nozzle throat diameter and propellant grain diameter and the shape factor, and between this relationship and the achievable performance parameter G. R.L.K.

N65-15019*# Little (Arthur D.) Inc., Cambridge, Mass.
SPACE TRANSPORT CAPABILITIES OF CHEMICALLY-FUELED PROPULSION SYSTEMS USING STORABLE AND CRYOGENIC PROPELLANTS Summary Report
J. M. Bonneville and A. A. Fowle Jun. 1964 75 p refs
(Contract NASw-876)
(NASA-CR-60128; C-66178) OTS: HC $3.00/MF $0.75

This report documents the results of investigations into the relative transport capabilities of chemically fueled upper stages using cryogenic and storable propellant combinations; these stages are designed to meet the same space mission objectives in a near optimum manner. A terminal maneuver after a coast period characterizes the missions forming the basis of comparative evaluations. Various stage weights, propellant combinations, space storage methods, and thermal insulation systems are considered. Author

N65-15049 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
RESEARCH IN THE FIELD OF CHEMICAL PROPULSION
Marcel Barrère Dec. 1964 80 p Transl. into ENGLISH of a rept. on the Conf. held during the study sessions on Chem. Propulsion, Centre Natl. d'Etude Spatiales, Paris, 4–6 May 1964
(CPIA-67)

Various problems relating to chemical propulsion are reviewed. The research is divided into two categories, depending on whether or not the problems are associated with the combustion phenomenon and indicating those common to the three chemical systems that are distingushed by the physical state of the propellant: solid, liquid, or mixed. From an energy standpoint, a hybrid systen leads to the highest specific impulse. Also, it is the only system which allows an appreciable increase in performance; and the optimum is obtained with a three-component propellant. It is indicated that research on combustion phenomena varies, depending upon the propulsion mode, and is prescribed mostly by the development of the propulsion unit. Generally, such studies are oriented toward analysis of heterogeneous combustion. It is concluded that, faced with the increasing demands placed on the propulsion system, overall chemical propulsion is oriented toward hybrid systems. R.R.D.

N65-15089 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genèse (Belgium)
APPROXIMATE ANALYTICAL SOLUTION FOR LOW THRUST PROPULSION IN SPACE
L. Moulin May 1964 46 p refs
(Grant AF-EOAR-63-39)
(TN-16; AD-603175)

Approximate analytical solutions are derived for the problem of low thrust propulsion, in the case of constant thrust, set at a constant angle to the velocity vector, for any type of initial orbit (elliptic, parabolic, or hyperbolic). Simple expressions are obtained, giving energy, angular momentum, and excentricity in terms of the excentric anomaly. The solutions allow for calculation of the fuel consumption, and their validity is restricted to the field of orbit correction. Author

N65-15155*# National Aeronautics and Space Administration, Washington, D.C.
HYBRID ROCKET PROPULSION [LA PROPULSION PAR FUSEES HYBRIDES]
M. Barrère and A. Moutet Feb. 1964 73 p refs Transl. into ENGLISH of a paper presented at the 14th Intern. Astronautical Congr., Paris, 25 Sep.–1 Oct. 1963
(NASA-TT-F-8806) OTS: HC $3.00/MF $0.75

This article demonstrates the potentialities of hybrids in the space program, which are applicable to all three main classes of chemical rockets currently in use, namely, storable-propellant rockets, cryogenic-propellant rockets, and semi-storable-propellant rockets, where the nonstorable element is introduced at the time of firing. On the basis of these three categories, the properties of hybrid systems are discussed in relation to the specific impulse. The hybrid method of propulsion is compared with standard solid- and liquid-propellant propulsion systems. The fundamental problems of combustion, with the emphasis being placed on the rate of regression of the solid phase, which determines the performance of the system are also discussed. Different theories of the regression rate are described and compared with various experimental results. Author

N65-15226*# McDonnell Aircraft Corp., St. Louis, Mo. Research Div.
ANALYSIS OF AN ARC-JET EXHAUST
W. M. Van Camp, F. D. Mc Vey, D. W. Esker, R. J. Checkley, S. E. Merrifield et al Dec. 1964 62 p
(Contract NAS3-3562)
(NASA-CR-54102; A984) OTS: HC $3.00/MF $0.75

Techniques are reported for measuring the performance characteristics and nozzle exit-plane plasma parameters of hydrogen arc-jet thrustors operating in the power range of 17 to 33 kW and vacuum exhaust conditions of 0.40 to 1.40 torr. Water-cooled and radiation-cooled hydrogen arc-jet thrustors are described in terms of physical dimensions and performance parameters. Measurements are reported of thrust, specific impulse, stagnation enthalpies at the exit plane, mass flux nozzle exit-plane velocities, electron beam attenuation in varying density environments of hydrogen, helium, and argon, and electron densities. D.E.W.

N65-15230*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
AN EXPERIMENTAL EVALUATION OF ARRAY OF THREE ELECTRON-BOMBARDMENT ION THRUSTORS
Eugene V. Pawlik Washington, NASA, Jan. 1965 47 p refs
(NASA-TN-D-2597) OTS: HC $2.00/MF $0.50

Three 20-cm-diam electron-bombardment ion thrustors mounted in a close lateral array were used in a systematic investigation of steady-state interaction among thrustors, ion-beam neutralization, and beam spreading. The thrustors used mercury as the propellant and were operated at 4500 V net accelerating potential and at beam currents that ranged from 0.75 to 3.0 A for the array. No significant electrical interaction between thrustor modules was observed. Neutralization of the ion beam was accomplished with three immersed emitter-type neutralizers consisting of twisted tantalum wires strung across the diameter of each module. A beam collector was electrically isolated from the vacuum tank so that the effectiveness of the neutralizers could be determined. Beam potentials were approximately determined by measuring the collector potential. A neutral exhaust beam could be achieved with any neutralizer that was coupled to the aggregate beam through the plasma. A rake of impingement probes that could be swept through the exhaust of the array was used to determine beam spreading. Mean cone angles of about 10° existed for each thrustor. Skew of the thrust vector was noticeable for most modules. Thrust levels as high as 0.393 N (88 millipounds) were achieved by the array. Author

N65-15270# Lyon, Inc., Detroit, Mich.
DEVELOPMENT OF DEEP DRAWN—ONE-PIECE HIGH PERFORMANCE ROCKET MOTOR CASE General Report No. 23 (Final), Jan. 1–Sep. 30, 1963
C. J. Porembski 1 Sep. 1964 25 p
(Contract DA-20-018-ORD-23004)
(AD-607324)

Development of improved monolithic rocket motor cases for 40-in.-diam (and over) solid propellant rockets was continued. Subscale studies were conducted on 18%- and 20%-nickel maraging alloys and on 18% nickel–9% cobalt–5% molybdenum maraging alloys. The results of the subscale tests indicated that full-size monolithic (high-strength) maraging-alloy rocket chambers can feasibly be produced by the deep draw method. One case (Ladish D-6AC alloy case CF-1) was successfully hydrostatically and dynamically tested at −65° F. After proof testing at −65° F, the case was taken to burst pressure at the same temperature. The resulting break was 100% ductile. The successful hydrotesting of the case is concluded to indicate that the hot cup–cold deep draw process is a satisfactory and reliable method for producing high-strength, high-performance monolithic rocket motor cases. P.V.E.

N65-15271# Toronto U. (Canada). Inst. for Aerospace Studies
AN EXPERIMENTAL INVESTIGATION INTO THE SHAPE OF THRUST AUGMENTING SURFACES IN CONJUNCTION WITH COANDA-DEFLECTED JET SHEETS, PART I
C. D. Hope-Gill Jul. 1964 87 p refs
(Grant DA-TC-44-177-G1)
(UTIAS-TN-70)

By means of additional surfaces, the thrust of a jet or jet sheet can be enhanced (thrust augmentation). This applies especially to Coanda-deflected jet sheets because of the inherent stronger entrainment into curved flow surfaces. The flow from a two-dimensional subsonic nozzle was deflected by quadrants. A composite thrust-augmenting surface was added, and the effect of its shape on thrust augmentation was studied at various nozzle pressure ratios and radii of the quadrants. This investigation yielded a maximum thrust augmentation of 1.21 for several optimum configurations, which was governed primarily by the relative magnitude and direction of the momentum of the secondary (entrained) flow in relation to the primary (nozzle) flow momentum. Thrust augmentation decreased with increasing nozzle pressure ratio but was independent of the quadrant radius. Some of the observed results were predicted theoretically. Author

N65-15334*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HEAT TRANSFER AND PRESSURE INVESTIGATIONS OF AN SI/S-IV STAGE SEPARATION MODEL USING SHORT-DURATION TECHNIQUES. VOLUME I: INTRODUCTION AND GENERAL METHOD
C. L. Matthis Jun. 1964 72 p refs
(Contract NAS8-823)
(NASA-CR-60284; CAL-HM-1510-Y-11) OTS: HC $3.00/MF $0.75

An application of the short duration technique for simulating liquid propellant rockets is described. The project described is the high-altitude investigation of the heat-transfer and pressure environment encountered in the interstage region during a "fire-in-the-hole" separation of the S-IV second stage and the S-I first stage of the Saturn I launch vehicle. The S-IV stage propulsion system utilizes a cluster of six RL 10-A3 liquid hydrogen–liquid oxygen rocket engines. Among the parameters investigated in this 1/10-scale-model simulation program were interstage vent size and shape, location and number of vents, stage separation distance, separation plane, engine gimbaling and engine out, one vent panel not out, blast deflector configuration, heat shield shroud configuration, ambient altitude, and rocket engine chamber pressure and O–F ratio. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-14582# International Geophysical Year World Data Center A, Boulder, Colo. High Altitude Obs.
SOLAR ACTIVITY: ADDENDA TO REPORTS OF PROMINENCES, 1960–1963
15 Dec. 1964 47 p
(IGY Solar Act. Rept. Ser.-30)

A collection of solar prominence activity data from three Russian astrophysical observatories is presented. The data were gathered during various months of the years 1960 to 1963. The phenomena observed were the active dark filament, the active filament and active prominence regions, the bright surges on the disk and at the limb, and the dark surge on the disk. G.G.

N65-14605*# Consultants and Designers, Inc., Arlington, Va.
NATURE OF DISCRETE SOURCES OF X-RAYS [O PRIRODE DISKRETNYKH ISTOCHNIKOV RENTGENOVSKIKH LUCHEY]

V. L. Ginzburg and S. I. Syrovatskiy 23 Nov. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Astron. (Moscow), v. 158, no. 4, 11 Oct. 1964 p 808–810
(Contract NAS5-3760)
(NASA-TT-F-8998; ST-SA-CR-10247) OTS: HC $1.00/MF $0.50

A possible hypothesis on the nature of extragalactic X-ray sources is discussed. It is assumed that the magnetobremsstrahlung nature of X-ray emission from discrete sources is acceptable. The identification of these sources with neutron stars is reliable only on exclusion of other possibilities, and in particular, the magnetobremsstrahlung model discussed here.
Author

N65-14610*# Consultants and Designers, Inc., Arlington, Va.
SOME POSSIBILITIES OF DETECTION OF HIGH FREQUENCY TURBULENCE OF COSMIC PLASMA [O NEKOTORYKH VOZMOZHNOSTYAKH DETEKTIROVANIYA VYSOKOCHASTOTNOY TURBULENTNOSTI KOSMICHESKOY PLASMY]
V. N. Tsytovich 10 Dec. 1964 6 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 5, 1964 p 992–995
(Contract NAS5-3760)
(NASA-TT-F-9604; ST-PP-RWP-10248) OTS: HC $1.00/MF $0.50

The variations of the wave spectrum and of wave scattering are computed in the case of propagation through turbulent plasma. It is shown that at passage of the 21-cm line near the sun, the spectrum is broadened and shifted toward the long-wave side. A red component appears, with a frequency which differs from the mean frequency of the line by an order of plasma vibrational frequency. In turbulent plasma, in which the characteristic phase velocity of the waves is much smaller than the speed of light, the scattering of electromagnetic waves greatly exceeds the shift and broadening of the spectrum. The possibility of applying these effects for the determination of the intensity of high-frequency turbulence of cosmic plasma is discussed.
Author

N65-14612*# Consultants and Designers, Inc., Arlington, Va.
POSSIBILITY OF X-RAY EMISSION BY RADIOWAVE SOURCES OF OUTER SPACE [VOZMOZHNOST' RENTGENOVSKOGO IZLUCHENIYA U KOSMICHESKIKH RADIOISTOCHNIKOV]
G. A. Gurzadian 9 Dec. 1964 9 p refs Transl. into ENGLISH from Astron., Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 6, 1964 p 1291–1294
(Contract NAS5-3760)
(NASA-TT-F-9608; ST-IGA-10257) OTS: HC $1.00/MF $0.50

Three possible types of X-ray (1 to 100 Å) generation are indicated for radio sources in outer space: bremsstrahlung of relativistic electrons in the medium's magnetic fields; bremsstrahlung of nonrelativistic electrons in the proton field; and emission at nuclear transmutations. The first type is considered at length, and expressions are derived indicating that, in the absence of absorption inside the object emitting X-rays, the observed energy intensity is inversely proportional to the frequency, and that the observed number of X-rays in a unitary interval of wavelengths is constant and independent of the wavelength. The expected number of X-ray quanta, entering earth in 1 sec/1 cm^2, originating from Galaxy M82 and from the Crab Nebula are calculated as examples. Although the computed emitting capability of these objects is only a few tens of quanta/sec/1 cm^2, it is still within the sensitivity threshholds of the best detectors. Consideration of the second type of X-ray generation shows that there is very little probability that is would be an important source of X-ray emission in radiogalaxies, standard galaxies, or the remains of supernovae, but may have a certain role in dense planetary and diffuse nebulae. The third type of X-ray generation is of little practical interest.
M.P.G.

N65-14616*# Consultants and Designers, Inc., Arlington, Va.
STUDY OF THE VARIABILITY OF THE TOTAL IONIZING COMPONENT OF COSMIC RAYS [IZUCHENIYE IZMENCHIVOSTI OBSHCHEY IONIZIRUYUSHCHEY KOMPONENTA KOSMICHESKIKH LUCHEY]
Yu. Dubinski and L. Khalupka 24 Dec. 1964 4 p Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 945–947
(Contract NAS5-3760)
(NASA-TT-F-9616; ST-CR-10265) OTS: HC $1.00/MF $0.50

To determine the total ionizing component of cosmic rays, two wide-angle telescopes were used to measure the intensity. Each telescope consisted of two series of Geiger counters, spaced at 22 cm, with an effective area of 0.96 m^2. Approximately 9000 pulses a minute were registered, reducing the statistical error to about 1 percent. The relationship of variable intensities to magnetic field variations was also studied and formulas were determined for plotting the interconnection. As the observations were conducted during a period of low solar activity, there was neither a Forbush decrease or sudden increase in cosmic ray intensity.
M.G.J.

N65-14617*# Consultants and Designers, Inc., Arlington, Va.
CHARACTER OF THE SPACE-TIME DISTRIBUTION OF SOLAR COSMIC RAYS IN INTERPLANETARY SPACE [O KHARAKTERE PROSTRANSTVENNO-VREMENNOGO RASPREDELENIYA SOLNECHNYKH KOSMICHESKIKH LUCHEY V MEZHPLANETNOM PROSTRANSTVE]
L. I. Dorman and L. I. Miroshnichenko 29 Dec. 1964 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 940–944
(Contract NAS5-3760)
(NASA-TT-F-9617; ST-CR-SP-10266) OTS: HC $1.00/MF $0.50

The departure of the true picture of solar-particle propagation from the classical diffusion theory discloses a dependence of the diffusion coefficient on the energy of particles, which is evident from the lag of low-energy particles in comparison with the high-energy ones. From general consideration of distribution of magnetic clouds in interplanetary space, it follows that the diffusion coefficient may depend on the distance of the sun and on the azimuth angle of the particle ejection. Owing to the radical motion of magnetic inhomogeneities from the sun, the intensity of flare particles descending to earth decreases faster than according to the law $\sim t^{-3}/2$, particularly for particles with low energy and for great values of t (time factor). It is important to stress that the anisotropy amplitude does not depend on the path for scattering and is inversely proportional to the velocity of particles and to the time from the commencement of the flare.
R.W.H.

N65-14618*# Consultants and Designers, Inc., Arlington, Va.
DETERMINATION OF PHYSICAL PARAMETERS OF SUN'S ATMOSPHERE BY THE METHOD OF CURVES OF GROWTH [OB OPREDELENII FIZICHESKIKH PARAMETROV ATMOSFERY SOLNTSA METODOM KRIVYKH ROSTA]

D. M. Kuli-Zade 30 Dec. 1964 17 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 19, issue 4, 1964 p 153–164
(Contract NAS5-3760)
(NASA-TT-F-9618; ST-CR-10267) OTS: HC $1.00/MF $0.50

Curves of growth for the center of the solar disk are plotted. Relative gf values of Fe I lines, measured by various methods and different researchers, are used. The physical parameters of the sun's atmosphere are determined independently in every case. It is shown that the parameters are not sensible to statistical dispersions in the determination of the relative gf values of Fe I lines. It is also shown that they do not practically depend on the adopted model of the solar atmosphere. Author

N65-14619*# Consultants and Designers, Inc., Arlington, Va.
TEMPERATURE EFFECT OF THE NEUTRON COMPONENT OF COSMIC RAYS IN A PERIOD OF HIGH SOLAR ACTIVITY [TEMPERATURNYY EFFEKT NEYTRONNOY KOMPONENTY KOSMICHESKIKH LUCHEY V PERIOD VYSOKOY SOLNECHNOY AKTIVNOSTI]
N. S. Kaminer, S. F. Ilgach, and T. S. Khadakhanova 31 Dec. 1964 5 p refs Transl into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 5, 1964 p 946–947
(Contract NAS5-3760)
(NASA-TT-F-9619; ST-CR-10268) OTS: HC $1.00/MF $0.50

Cosmic ray data for the years 1957–58 and 1959–60, a period of increasing solar activity, were analyzed to determine the variation of the neutron component due to atmospheric temperature variations by using a method whereby the variations due to primary radiation are eliminated. These results are compared to data from the same stations analyzed in the same way for 1960–1962, a period of decreasing solar activity. The data for both periods were then averaged, and the amplitude of the seasonal wave in the neutron component was found to exceed the theoretical calculated value by 2.1 times. The possibility that the temperature effect was due to anisotropy of the primary radiation was disproved. The steady seasonal wave found in the neutron component for periods of both increasing and decreasing solar activity is therefore considered as most probably due to the seasonal temperature change in the atmosphere. M.P.G.

N65-14620*# Consultants and Designers, Inc., Arlington, Va.
DISTRIBUTION OF COSMIC RAY INTENSITY IN THE ATMOSPHERE TO 500 KM HEIGHT [RASPREDELENIYE INTENSIVNOSTI KOSMICHESKIKH LICHEY V ATMOSFERE DO VYSOTY 500 KM]
Yu. G. Shafer, V. D. Sokolov, N. G. Skryabin, V. F. Lyutenko, A. V. Yarygin et al 4 Jan. 1965 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, p 928–932
(Contract NAS5-3760)
(NASA-TT-F-9620; ST-CR-10270) OTS: HC $1.00/MF $0.50

It is shown that the intensity of primary cosmic radiation at middle latitudes is not subject to substantial secular variations and is respectively equal at 100 and 500 km to 0.125 and 0.135 particle·cm^{-2}·sec^{-1}·sterad^{-1} Author

N65-14621*# Consultants and Designers, Inc., Arlington, Va.
ON SOME RESULTS OF MEASUREMENTS OF THE EAST-WEST ASYMMETRY IN THE INTENSITY OF PRIMARY COSMIC RADIATION [NEKOTORYYE REZUL'TATY IZMERENIY VOSTOCHNO ZAPADNOY ASIMMETRII V INTENSIVNOSTI PERVICHNOGO KOSMICHESKOGO IZLUCHENIYA]
Yu. G. Shafer, V. D. Sokolov, N. G. Skryabin, S. K. Dergeym, and R. B. Salimzibarov 4 Jan. 1965 6 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, Nov.–Dec. 1964 p 933–935
(Contract NAS5-3760)
(NASA-TT-F-9621; ST-CR-10271) OTS: HC $1.00/MF $0.50

A brief description is given of the experimental installation for the measurements of the effect of cosmic radiation's east-west asymmetry. The measurements were conducted in the 100- to 500-km-altitude range. The lower boundary of albedo particle intensity and the effect of the east-west asymmetry of primary cosmic radiation were determined from experimental data. Author

N65-14827# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
ELECTRON AND PROTON FLUXES IN THE TRAPPED RADIATION BELTS ORIGINATING FROM AN ORBITING NUCLEAR REACTOR
John C. Ringle, Ludwig Katz, and Don F. Smart Oct. 1964 32p refs *Its* AF Surveys in Geophys. No. 159
(AFCRL-64-865; AD-608784)

A simple calculation is done to determine the effects of an orbiting nuclear reactor on the trapped radiation belts. A SNAP-50 reactor, in an equatorial orbit at 1000 km and operating at 8 MW/thrm for a period of 1 year, is considered as a source of low energy electrons and protons. Neutrons escaping from the reactor decay into electrons and protons, and these can become trapped in the earth's magnetic field. Hence, they contribute to the natural fluxes in the radiation belts. Three different source problems are considered: (1) those neutrons which decay within one kilometer of the reactor; (2) those neutrons which decay within the entire inner radiation belt; and (3) those neutrons which decay within the entire outer radiation belt. In each region the average equilibrium of reactor-produced electron and proton fluxes at the equator are calculated after reactor operation for 1 year. Author

N65-14849*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
COSMIC RAY COLLISIONS IN SPACE. PART I: THE ENERGY SPECTRA OF ELECTRONS FROM PION-MUON-ELECTRON DECAYS IN INTERSTELLAR SPACE Final Report
Joseph H. Scanlon and S. N. Milford Washington, NASA, Jan. 1965 191 p refs
(Contract NASw-699)
(NASA-CR-148) OTS: HC $5.00/MF $1.25

In a program to calculate the distribution of stable secondary particles resulting from high-energy collisions of cosmic rays with the interstellar gas, the energy spectra of electrons from charged pion decays in interstellar space were determined. The analysis started with the known distribution of electrons from muon decay in the muon rest frame. After Lorentz transformation to the pion rest frame, the muon distribution from pion decay was introduced. All directions were related to a fixed set of axes. The muon momentum and the angular dependence were then integrated out. A second relativistic transformation yielded the electron energy and angular distribution in the system in which the pion decays in flight. Integration over the electron direction then gave the energy spectra of the electrons. Numerical values of the electron energy spectra were computed on an IBM 7094 for 26 pion kinetic energy values from 3 to about 110 MeV. D.S.G.

N65-14850*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

COSMIC RAY COLLISIONS IN SPACE. PART II: HIGH ENERGY GAMMA RAYS FROM COSMIC RAY COLLISIONS IN SPACE Final Report, Jul. 3, 1963–Nov. 3, 1964

M. Lieber, S. N. Milford, and M. S. Spergel Washington, NASA, Jan. 1965 113 p refs

(Contract NASw-699)

(NASA-CR-149) OTS: HC $4.00/MF $0.75

A major source of very-high-energy cosmic gamma rays is the collision of high-energy cosmic-ray protons with intergalactic gas. High-energy gamma rays are produced directly through the decay of neutral pions which are present as secondaries in the collision. The Landau–Milekhin relativistic hydrodynamic model, which visualizes the colliding high-energy protons as fluids, is used to obtain the pion distributions in both energy and angle; these are in good agreement with available data. A source function for gamma rays of energy above 10 BeV is found by combining the pion production and decay spectra with the primary cosmic-ray proton flux. The resulting gamma-ray spectrum follows a different power law than spectra based upon the usual assumption of a line spectrum for the pions in the center of mass system of the colliding protons. The high-energy gamma-ray intensity in space is calculated for a simple Euclidean expanding universe. Author

N65-14851*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

COSMIC RAY COLLISIONS IN SPACE. PART III: LOW ENERGY PROTONS FROM COSMIC RAY COLLISIONS IN SPACE Final Report, Jul. 3, 1963–Nov. 3, 1964

M. Ferentz and S. N. Milford Washington, NASA, Jan. 1965 27 p refs

(Contract NASw-699)

(NASA-CR-150) OTS: HC $2.00/MF $0.50

The intensity of low-energy cosmic ray protons produced by the collisions of higher energy cosmic ray protons with the interstellar gas is calculated. The calculation consists of two parts: (1) The physics of the high-energy elastic proton–proton collisions is used to calculate the production rate of recoil protons as a function of energy. A simple astrophysical model in which the low energy cosmic rays diffuse in an infinite interstellar medium and are removed from a given energy range by atomic slowing collisions, nuclear collisions, and sudden disappearance (corresponding to escape from our galaxy) is considered. (2) Using the diffusion model and the derived source strength, the low energy cosmic ray proton intensity is found for the energy range 0 to 500 MeV. For this single type source and diffusion model, the integral intensity above 1 MeV is about 0.02 cm^{-2} sec^{-1}. Author

N65-14852*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

COSMIC RAY COLLISIONS IN SPACE. PART IV: COSMIC RAY HAZARDS IN THE SOLAR SYSTEM Final Report, Jul. 3, 1963–Nov. 3, 1964

S. N. Milford Washington, NASA, Jan. 1965 51 p refs

(Contract NASw-699)

(NASA-CR-151) OTS: HC $3.00/MF $0.50

This part of the report includes the following subjects: (1) the direct measurements of cosmic ray energy and charge spectra near the earth—underground, sea level, altitudes within the earth's atmosphere and outside the earth's atmosphere, but within the geomagnetic field; (2) measurements in interplanetary space near the earth; (3) the theory of the effects of planetary magnetic fields and atmospheres in modifying the spectra; (4) the intensity of interplanetary cosmic rays in the outer solar system—meteorites, high-energy cosmic rays, and theoretical estimates of the intensity of low-energy cosmic rays; and (5) an estimation of the radiation doses for the various regions mentioned. In general, it is concluded that the known hazard presented by cosmic rays is appreciable only for long-term space missions. P.V.E.

N65-15002# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

DETERMINATION OF MACROSCOPIC VELOCITIES FROM LINE PROFILE ASYMMETRIES

J. L. Kulander Dec. 1964 42 p refs Presented at 117th meeting of the AAS in Joint Session with Sect. D-Astronomy of the AAAS, Montreal, 28–31 Dec. 1964

(R64SD88)

Synthetic line profiles are generated for model atmospheres containing linear and quadratic velocity fields and various temperature distributions. The LTE and non-LTE source functions and both weak and strong lines are considered. Comparison of the assumed velocity structures with those inferred from the bisector shifts of the asymmetrical profiles show qualitative correlation only on the line cores and in general only for velocities small compared with the thermal velocity. A constant asymptotic velocity is inferred in the semi-infinite atmospheres below certain limiting depths for both strong and weak lines. Approximate expressions relating observed profile parameters to atmospheric velocity parameters for small linear velocities are obtained and tested for the constant temperature case. The observed rms displacements in the solar H-α line are used to infer the amplitude of the oscillatory velocity field in that region of the solar chromosphere where the core is formed. Author

N65-15150*# Consultants and Designers, Inc., Arlington, Va.

STUDY OF THE SLOWLY VARIABLE COMPONENT AT 9400 MC AS A FUNCTION OF SOLAR ACTIVITY [ETUDE DE LA COMPOSANTELENTEMENT VARIABLE SUR 9400 MHz EN FONCTION DE L'ACTIVITE SOLAIRE]

C. Caroubalos Nov. 1963 6 p refs Presented at the Symp. on Phys. of Solar Flares

(Contract NAS5-2078)

(NASA-TT-F-8636; ST-SP-10061) OTS: HC $1.00/MF $0.50

Only the most intense centimeter wave condensations are attended by type-IV bursts; the frequency of these repetition centers does not appear to be constant in the course of a solar activity cycle. The solar activity is localized in the "privileged" regions of the solar disk, as is apparent even in visual inspection. This localization is a consequence of the activity of the centers themselves. D.E.W.

N65-15162*# Consultants and Designers, Inc., Arlington, Va.

DIFFUSION MECHANISM OF THE DAILY VARIATION OF COSMIC RAYS [DIFFUZIONNYY MEKHANISM SUTOCHNOY VARIATSII KOSMICHESKIKH LUCHEY]

G. F. Krymskiy 18 Jan. 1965 17 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 6, 1964 p 977–986

(Contract NAS5-3760)

(NASA-TT-F-9626; ST-CR-IS-10277) OTS: HC $1.00/MF $0.50

The anisotropy of cosmic rays under the effect of solar wind is considered from the standpoint of its formation. If the magnetic field has a regular component, an anisotropy must be observed with a maximum lying at right angle to the east from the sun. The anisotropy amplitude is computed

as a function of the solar wind and of the degree of irregularity of the magnetic field, which is characterized by the ratio of the transverse diffusion coefficient of cosmic rays to the longitudinal one. The accounting of the effect of the induced electric field and of cosmic ray deceleration in the solar wind shows that, in case of a spherical wind with irregular isotropic field, the anisotropy will be absent. If the wind is bounded by low heliolatitudes, anisotropy of cosmic rays must be observed, with a maximum from the side of the sun. Author

N65-15164*# Consultants and Designers, Inc., Arlington, Va.
CYCLOTRON RADIATION CHARACTERISTICS AS A FUNCTION OF MAGNETIC DIPOLE ORIENTATION [ZAVISIMOST' KHARAKTERISTIK TSIKLOTRONNOGO IZLUCHENIYA OT ORIENTATSII MAGNITNOGO DIPOLYA]
N. A. Lotova and A. K. Markeyev 19 Jan. 1965 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 6, 1965 p 1015–1019
(Contract NAS5-3760)
(NASA-TT-F-9628; ST-GM-PF-10278) OTS: HC $1.00/MF $0.50

Calculation of Stokes-parameter expressions in a dipole magnetic field is presented for the case of cyclotron radiation at arbitrary inclination of the dipole relative to visual ray. The degree of polarization, ellipticity, and the relative variation of radiation intensity is computed for various inclination angles of the dipole. Author

N65-15167# Canada. Dept. of Transport, Toronto. Meteorological Branch
THE REDUCTION OF SOLAR RADIATION BY ATMOSPHERIC POLLUTION AT TORONTO, CANADA
J. H. Emslie 25 Aug. 1964 11 p refs
(CIR-4094; TEC-535)

The reduction of solar radiation by atmospheric pollution is demonstrated graphically by plotting simultaneous, mean, total solar-radiation data for an urban and a suburban location. During each of the four seasons, the urban location receives somewhat less radiation, but the effect is not nearly as marked as that of an urban vs rural investigation. A comparison of solar radiation on Sunday and Wednesday agrees with the work of Mateer in that the excess solar radiation formerly observed on Sunday is not now consistently evident. Author

N65-15323# High Altitude Observatory, Boulder, Colo.
MECHANISM OF DECAMETER RADIATION Scientific Report No. 5
J. W. Warwick Sep. 1964 17 p refs Presented at NASA Symp. on Jupiter, New York, 17 Oct. 1962
(Contract AF 19(628)-224)
(AFCRL-64-774; AD-607896)

This is a brief review of the principal results of dynamic spectral studies of Jupiter's decametric emission. The argument for a permanent dynamic spectrum, e.g., a function of radio longitude only, is worked out in detail. Its implication for Jupiter's magnetic field is discussed in detail. A number of pictures of actual records are presented. Author

N65-15404*# California U., La Jolla.
THE ANOMALOUS ENERGY SPECTRUM OF PROTONS IN THE EARTH'S RADIATION BELT
R. Walker Fillius (State U. of Iowa) and Carl E. Mc Ilwain [1963] 9 p refs
(Contracts NAS5-1683; NASr-116; Grant NsG-538)
(NASA-CR-60346) OTS: HC $1.00/MF $0.50

The measurement of the spatial distribution and energy spectrum of trapped protons over a broad region of space from 2500 to 7500 km in altitude is reported. The launching, orbit, and instrumentation of the Relay I satellite are described, and graphs are presented which display the intensities of low energy protons, the fluxes of protons mirroring at the equator, and the proton energy spectra at the magnetic equator. It is concluded that no single power law, nor any other obvious relationship such as exponential, gaussian, etc., fits the entire spectrum, and that the theory of geomagnetically trapped protons is incomplete. D.E.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-14541*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RANGER VI FLIGHT PATH AND ITS DETERMINATION FROM TRACKING DATA
W. L. Sjogren, D. W. Curkendall, T. W. Hamilton, W. E. Kirhofer, A. S. Liu et al 15 Dec. 1964 202 p refs
(Contract NAS7-100)
(NASA-CR-60056; JPL-TR-32-605) OTS: HC $6.00/MF $1.25

This report describes the current best estimate of the Ranger VI spacecraft flight path and the way in which it was determined. Deep Space Instrumentation Facility tracking of the spacecraft was virtually continuous from injection to lunar impact. Postflight analysis of the tracking data resulted in valuable determinations of the masses of the earth and the moon tracking station locations, lunar ephemeris scale factor, and a lunar radius to the Ranger VI impact point, which is 3 km less than the previously accepted value. The impact location of Ranger VI is known to within 1.2 km on the surface of the moon. Author

N65-14604*# Consultants and Designers, Inc., Arlington, Va.
ON THE RESULTS OF CERTAIN WORKS ON THE THERMAL HISTORY OF THE MOON [PO POVODU NEKOTORYKH RABOT O TEPLOVOY ISTORII LUNY]
O. I. Ornatskaya 23 Nov. 1964 5 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 5, 1964 p 995–997
(Contract NAS5-3760)
(NASA-TT-F-8997; ST-LPS-10246) OTS: HC $1.00/MF $0.50

Contradictory results obtained from two works (B. Yu. Levin and S. V. Mayeva, and B. Yu. Levin) devoted to the thermal history of the moon are discussed. It is shown that the results, which can be deduced from these papers, lead to a contradiction of the very model originally adopted in the works. P.V.E.

N65-14623*# National Aeronautics and Space Administration, Washington, D.C.
MOON BLINK NET ORGANIZED FOR LUNAR STUDY News Release No. 64-316
20 Dec. 1964 2 p
Available from the Scientific and Technical Information Division

An instrument was developed by NASA's Office of Advanced Research and Technology that verifies and locates color on the lunar surface. It consists essentially of rotating color disks which appear to blink when red color appears on the moon. This instrument is used by a number of observers in the operation "Moon Blink," and is being developed for detection of unusual coloration on all types of bodies orbiting in space. G.G.

N65-14624* Israel Program for Scientific Translations, Ltd., Jerusalem.
PHOTOGRAPHIC METHODS IN METEOR ASTRONOMY
L. A. Katasev 1964 120 p refs Transl. into ENGLISH of the book "Fotograficheskie Metody Meteornoi Astronomii" Moscow, Gos. Izd. Tekhn.-Teor. Lit., 1957 Published for NSF and NASA
(NASA-TT-F-142)

Photographic methods of meteor study, the equipment necessary, and the measurement and interpretation of meteor photographs are detailed in this study. Particular emphasis is given to formulas for photographic determination of radiant position, meteor heights, meteoroid velocities and the dependence of meteor heights on velocity, apparent and absolute brightness and magnitudes of meteors, spectra, orbits, and visual and photographic observations of meteoric phenomena in the upper atmosphere. The origin of meteoroids and their association with other bodies of the solar system are presented in a comparative statistical study. M.G.J.

N65-14628*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME EFFECTS OF UNCERTAINTIES IN ATMOSPHERE STRUCTURE AND CHEMICAL COMPOSITION ON ENTRY INTO MARS
Robert L. Mc Kenzie Washington, NASA, Jan. 1965 36 p refs
(NASA-TN-D-2584) OTS: HC $2.00/MF $0.50

Provided are examples of the degree to which uncertainties in the structure and composition of the Martian atmosphere affect various aspects of entry. The discussion contains the effects on manned-vehicle entry corridors, aerodynamic heating, including shock-layer radiation for an unmanned probe-type entry, and vehicle design requirements for an unmanned probe soft landing. The results indicate that current uncertainties in atmosphere scale height are significant in that they greatly decrease the entry corridor heights for manned vehicles. Uncertainties in the atmosphere composition and scale height are shown to preclude accurate prediction of the heating rates for an unmanned probe entry. However, as expected, requirements for soft landings are the most restrictive. Already difficult to satisfy because of low surface pressure, these requirements become extremely limiting because of the uncertainty in atmosphere structure. Author

N65-14632*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MARS NONSTOP ROUND-TRIP TRAJECTORIES
Roger W. Luidens and Jay M. Kappraff Washington, NASA, Jan. 1965 40 p refs
(NASA-TN-D-2605) OTS: HC $2.00/MF $0.50

Manned and unmanned nonstop round trips may be precursors of the first manned landing on Mars. Lightweight vehicle systems and short mission durations are desirable. Three kinds of nonstop round-trip trajectories are analyzed. They are characterized by the method of turning that is used at Mars: (1) gravity only, (2) gravity supplemented by propulsion, and (3) gravity supplemented by aerodynamic forces. These trajectories are compared for the years 1970 to 1971 and 1979 to 1980 on the basis of total propulsive velocity increment, mission duration, Earth entry velocity, and view of Mars. For the missions using aerodynamic forces, the vehicle lift-drag ratio, g-load, and Mars entry velocity are presented. Gravity turns occur only with mission durations near 360 or 550 days. The faster trips require the higher propulsive velocity increments. Author

N65-14653*# New Mexico U., University Park. Research Center
OBSERVATIONS OF THE RED SPOT ON JUPITER
Bradford A. Smith and Clyde W. Tombaugh 15 Apr. 1963 8 p ref
(Grant NsG-142-61)
(NASA-CR-50303; TN-557-63-2) OTS: HC $1.00/MF $0.50

Unfiltered photographs on blue plates were made of the red spot on Jupiter between June 1962 and January 1963. Two separate estimates of the average transit image on each of the plates were made and converted to the proper System II longitude of Jupiter. A red spot acceleration was observed around November 10, 1962. The longitude of the red spot increased at a rate of 0.025 ± 0.008 degrees daily until the middle of January 1963. A major, rapidly spreading disturbance in the south equatorial belt was detected in September 1962 and made contact with the red spot in the first week of November. No definite evidence was found that the red spot acceleration was directly related to the south equatorial disturbance. G.G.

N65-14655*# Geophysics Corp. of America, Bedford, Mass.
THE EFFECT OF CLOUDINESS ON A GREENHOUSE MODEL OF THE VENUS ATMOSPHERE
George Ohring and Joseph Mariano May 1963 33 p refs
(Contract NASw-704)
(NASA-CR-51176; GCA-TR-63-17-N) OTS: HC $2.00/MF $0.50

In previous models of the greenhouse effect in the Venus atmosphere, it has been assumed that infrared-absorbing atmospheric gases provide the sole contribution to the infrared opacity of the Venus atmosphere. In the present study, the influence of an extensive cloud cover, opaque to infrared radiation, is also included in the greenhouse model. The magnitude of the greenhouse effect, which is defined as the ratio of the surface temperature produced by the greenhouse to the surface temperature of an atmosphereless Venus, is computed as a function of infrared opacity of the atmosphere and amount and height (actually ratio of cloud-top pressure to surface pressure) of clouds. It is assumed that the Venus atmosphere is grey, the absorbing gas has a constant mixing ratio, and the temperature variation with altitude is linear. Calculations are made for two temperature lapse rates: the adiabatic lapse rate, and nine-tenths of the adiabatic lapse rate. Author

N65-14673* Israel Program for Scientific Translations, Ltd., Jerusalem.
THE NATURE OF THE PLANETS
V. V. Sharonov 1964 426 p refs Transl. into ENGLISH of the book "Priroda Planet" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1958 Published for NASA and NSF
(NASA-TT-F-77) OTS: $4.25

The nature of planets and satellites in the solar system is comprehensively treated from the practical or observational viewpoint. Topics covered include: (1) the solar system as

an object of physical investigation; (2) telescopic investigation of the surface of planets and satellites, along with their geometrical and mechanical characteristics; (3) planetary cartography and topographic descriptions of individual bodies in the solar system; (4) integrated-light photometry, and photometry of planetary disks; (5) optics of planetary atmospheres, and physical conditions on planets and satellites. A bibliography is given for each chapter, and the appendix lists the terminology recommended by the Commission on Planetary Physics of the Astronomy Board at the U.S.S.R. Academy of Sciences.

M.G.J.

N65-14701*# Consultants and Designers, Inc., Arlington, Va.
SOME CALCULATIONS OF THE THERMAL HISTORY OF MARS AND OF THE MOON [NEKOTORYYE RASCHETY TERMICHESKOY ISTORII MARSA I LUNY]
S. V. Mayeva 8 Jan. 1965 8 p refs Transl. into ENGLISH from Astron., Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 2, 1964 p 294–297
(Contract NAS5-3760)
(NASA-TT-F-9624; ST-LPS-10273) OTS: HC $1.00/MF $0.50

A continuation of research on the thermal history of the Earth and planets is discussed. Subjects reported are calculations of the heating of Mars, and calculations of the cooling and heating of the Moon. These calculations take into account (to a maximum degree) their formation process and their further development. P.V.E.

N65-14702# Oklahoma State U., Research Foundation, Stillwater.
A STUDY OF LINE INTENSITIES IN THE SPECTRUM OF θ URSAE MAJORIS Final Technical Report
Hugh Oscar Peebles (Ph.D. Thesis) Oct. 1963 192 p refs
(Grant Nonr(G)-00017-61)
(AD-423935)

Idealized curves of growth were applied in the analysis of absorption line intensities of the spectrum of the star θ Ursae Majoris. The equivalent widths were measured for 359 lines of Ca I, Ti I, Ti II, Cr I, Mn I, Fe I, Co I, and Ni I. The spectral region covered is λ4000 to λ6500, and only those lines which were sufficiently well resolved and unblended were used. Kinetic velocities, damping constants, excitation temperatures, and abundances were determined using the theoretical curves of growth based upon both the Milne–Eddington model and the Schuster–Schwartzschild model. Results were obtained for the extreme cases of pure scattering and pure absorption for the two models. D.S.G.

N65-14931*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-30, VOLUME VI FOR THE PERIOD SEPTEMBER 1, 1964 TO OCTOBER 31, 1964. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
W. H. Pickering 30 Nov. 1964 36 p
(Contract NAS7-100)
(NASA-CR-60102) OTS: HC $2.00/MF $0.50

In the lunar program, an investigation of Ranger launch-to-injection environment has led to the recommendation that launch vehicles be instrumented to provide actual and accurate flight data in order to better understand the flight environment and more specifically determine the electrostatic charging and discharging rates. The Ranger 7 trajectory profile and maneuver and encounter phases are also analyzed. Progress on systems development for the Surveyor spacecraft is discussed, and the model and vehicle designations are given. Successful systems testing of the Mariner spacecraft for planetary and interplanetary flights has been completed, along with thermal testing and the design and development of the video storage subsystem. The instrumentation and the special power supplies needed for operating the Deep Space Network are also reviewed.

M.G.J.

N65-14933*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A COMPREHENSIVE ASTRODYNAMIC EXPOSITION AND CLASSIFICATION OF EARTH-MOON TRANSITS
Gary P. Herring 21 Oct. 1964 205 p refs
(NASA-TM-X-53151) OTS: HC $6.00/MF $1.25

The restricted three-body model is used to develop a geometrical and topological taxonomy of the field of earth–moon transits (both directions) which is based on conditions at the terminals (perigee and perisel). It is presented in such a way as to promote mental control of the subject. The classifying techniques are then employed in the analysis of free-return transists as well as such problems as the lighting conditions upon landing. The report provides convenient reference material for the engineer involved in the layout of Apollo-type missions. Author

N65-15010# General Dynamics/Astronautics, San Diego, Calif.
STUDY OF INTERPLANETARY MISSIONS TO MERCURY THROUGH SATURN WITH EMPHASIS ON MANNED MISSIONS TO VENUS AND MARS 1973/82 INVOLVING CAPTURE
K. A. Ehricke 30 Sep. 1963 119 p refs
(GD/A-63-0916)

Several Earth launch vehicles are described and their relative merits are compared, with special emphasis on the importance of available transport volume (as well as transport weight) for simplifying orbital predeparture operations. Propulsion systems for the interplanetary vehicles and the cost of initial mission alternatives are considered with special emphasis on initial interplanetary missions in the 1975–77 period. Various mission modes are discussed, categorized by vehicle type, by powered maneuvers during the mission, and by vehicle assembly. The two-vehicle convoy concept is compared with a single vehicle consisting of two convoy vehicles coupled together. Finally, a comprehensive mission analysis is presented involving flight times, energy requirements, navigational aspects and solar radioative heat protection of hydrogen-carrying vehicles. Particular attention is directed toward fast capture missions to Venus and Mars in the 1973 through 1982 time period. Author

N65-15011*# Republic Aviation Corp., Farmingdale, N.Y. Research Div.
GENERAL PERTURBATION METHODS FOR CELESTIAL MECHANICS AND DIFFERENTIAL CORRECTION SCHEMES FOR THE CALCULUS OF VARIATIONS Summary Report, Dec. 20, 1962–Feb. 20, 1964
G. Nomicos, A. Garofalo, M. Payne, J. Morrison, J. Richman et al 20 Feb. 1964 200 p refs
(Contract NAS8-2605)
(NASA-CR-59852; RAC-720-10; RD-TR-64-3-6) OTS: HC $5.00/MF $1.25

CONTENTS:

1. THE HAMILTON-JACOBI FORMULATION OF THE RESTRICTED THREE BODY PROBLEM IN TERMS OF THE TWO FIXED CENTER PROBLEM M. Payne and S. Pines 38 p refs (See N63-18694 17-29)

2. APPROXIMATION OF THE RESTRICTED PROBLEM BY THE TWO-FIXED-CENTER PROBLEM M. Payne 29 p refs (See N65-15012 05-30)

3. TWO-POINT BOUNDARY-VALUE PROBLEM OF THE CALCULUS OF VARIATIONS FOR OPTIMUM ORBITS J. Richman 29 p refs (See N63-16803 14-29)

4. APPLICATION OF THE TWO FIXED CENTER PROBLEM TO LUNAR TRAJECTORIES 31 p ref (See N65-15013 05-30)

5. DIFFERENTIAL CORRECTION SCHEME FOR THE CALCULUS OF VARIATIONS G. N. Nomicos 26 p refs (See N64-12027 03-20)

6. APPLICATION OF VARIATION OF PARAMETERS TO THE POLAR OBLATENESS PROBLEM 27 p refs (See N65-15014 05-30)

7. APPROXIMATE INITIAL VALUES OF LAGRANGE MULTIPLIERS FOR THE TWO POINT BOUNDARY VALUE PROGRAM 15 p refs (See N65-15015 05-30)

N65-15012* Republic Aviation Corp., Farmingdale, N.Y. Research and Development Center
APPROXIMATION OF THE RESTRICTED PROBLEM BY THE TWO-FIXED-CENTER PROBLEM Second Semiannual Report, Part I
Mary Payne 20 Dec. 1962 *In its* Gen. Perturbation Methods for Celestial Mech. and Differential Correction Schemes for the Calculus of Variations 20 Feb. 1964 29 p refs (See N65-15011 05-30) OTS: HC $5.00/MF $1.25
(RAC-720-3; ARD-896-452)

A perturbation theory of the two-fixed-center problem leading to an approximation for the restricted-three-body problem is developed. It makes use of a generalization of the method developed by Schulz-Arenstorif, Davidson, and Sperling. The derivations are carried out in a coordinate system rotating about an accelerated origin, and the generalization consists of the selection of this origin in such a way as to minimize the effects of the nonintegrable terms in the perturbation equations. The results of some numerical calculations are presented. Author

N65-15013* Republic Aviation Corp., Farmingdale, N.Y.
APPLICATION OF THE TWO FIXED CENTER PROBLEM TO LUNAR TRAJECTORIES Third Semiannual Report, Part I
21 Jul. 1963 *In its* Gen. Perturbation Methods for Celestial Mech. and Differential Correction Schemes for the Calculus of Variations 20 Feb. 1964 31 p ref (See N65-15011 05-30)
(RAC-720-5; RD-TR-63-42) OTS: HC $5.00/MF $1.25

Six methods for the approximation of lunar trajectories by the two fixed center problem are developed. Four of these methods arise from a formulation of the restricted problem in a rotating coordinate system. The origin of the rotating system, to be regarded as the center of rotation, is to be so selected as to improve the degree of approximation. The other two are developed from a formulation in an inertial system with fictitious fixed positions of the earth and moon selected so as to improve the approximation. The results of a numerical comparison of the six methods with a typical lunar trajectory and the Kepler predictions are presented. These results are discussed and some suggestions are made for further development of the theory. Author

N65-15014* Republic Aviation Corp., Farmingdale, N.Y.
APPLICATION OF VARIATION OF PARAMETERS TO THE POLAR OBLATENESS PROBLEM Fourth Semiannual Report, Part I
19 Feb. 1964 *In its* Gen. Perturbation Methods for Celestial Mech. and Differential Correction Schemes for the Calculus of Variations 20 Feb. 1964 27 p refs (See N65-15011 05-30)
OTS: HC $5.00/MF $1.25
(RAC-720-7; RD-TR-64-3-2)

This report presents the derivation of a set of two-body parameters and their associated perturbation equations. These equations are applied to the polar oblateness problem characterized by the second spherical harmonic. A modified Poisson method is introduced in order to eliminate the occurrence of secular terms which, because of the parameters employed, would have caused a rapid deterioration of the solution. The approximate solution is expressed as a function to true anomaly. Some analysis of second-order theory is presented which suggests that difficulties with particular initial conditions may be avoided. Author

N65-15015* Republic Aviation Corp., Farmingdale, N.Y.
APPROXIMATE INITIAL VALUES OF LAGRANGE MULTIPLIERS FOR THE TWO POINT BOUNDARY VALUE PROGRAM Fourth Semiannual Report, Part II
19 Feb. 1964 *In its* Gen. Perturbation Methods for Celestial Mech. and Differential Correction Schemes for the Calculus of Variations 20 Feb. 1964 15 p refs (See N65-15011 05-30)
OTS: HC $5.00/MF $1.25
(RAC-720-8; RD-TR-64-3-3)

This report describes a method for obtaining a first estimate of initial values of the Lagrange multipliers for the two point boundary value problem of the calculus of variations. This first estimate is obtained by assuming the two impulse orbit transfer problem to be a reasonably close approximation to the calculus of variations problem. Author

N65-15023 RAND Corp., Santa Monica, Calif.
ATMOSPHERES OF THE PLANETS
G. F. Schilling Sep. 1964 30 p refs Submitted for Publication
(P-2964; AD-606026)

Known facts and proposed theories about the atmospheres of the various planets are presented in a general manner. In particular, an attempt is made to emphasize the causes and reasons why the planetary atmospheres still present a deep mystery as to their existence and makeup. P.V.E.

N65-15114# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE SPECTRAL-POLARIZATION CHARACTERISTICS OF THE LUNAR SURFACE
V. G. Tejfel 23 Oct. 1964 5 p refs Transl. into ENGLISH from Astron. Tsirkuliar Akad. Nauk SSSR (Kazan), no. 205 1959 p 7-8
(RSIC-312; AD-609159)

A spectrographic survey of the lunar surface near the quadratures was performed with the polaroid angled at 0°, 60°, and 120°. The monochromatic values of the polarization degree were calculated by Fesenkov's formula. The degree of the polarization in the spectra of the lunar details changed with the monochromatic magnitude of their albedos. Polarization measurements of the lunar earthlight showed a decrease by 5% to 7% of the wavelength in the interval 400mμ to 620mμ. G.S.

N65-15120# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
PETROGRAPHIC INVESTIGATION OF THE LUNAR SURFACE BY JOINT USE OF PHOTOMETRIC AND COLORIMETRIC OBSERVATIONS

V. V. Sharonov Dec. 1964 19 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 31, no. 5, 1954 p 442-452 (RSIC-344; AD-609693)

A statistical comparison between the lunar surface and the earth's rocks and materials with respect to color and luminosity was made. It was established that a simultaneous similarity for the distribution curves according to brightness and color between the moon on the one hand and the earth's rocks and meteorites on the other was not obtained. The various assumptions introduced in order to explain the color characteristics of the lunar surface are discussed. The most reliable is the hypothesis according to which the lunar surface is covered by a porous vesicular slag formed from bedrock under the action of explosions accompanying the meteorite impacts. Author

N65-15183# Smithsonian Astrophysical Observatory Cambridge, Mass.

THERMAL EFFECT ON THE ROTATIONAL PERIOD OF AN ARTIFICIAL SATELLITE

G. Colombo and P. Higbie 30 Nov. 1964 24 p refs
(GRANT NsG-87-09)
(NASA-CR-60229; SAO Special Rept.-166) OTS: HC $1.00/MF $0.50

An accurate determination of the instantaneous orientation of the Explorer XI Satellite (γ-ray telescope) was very important for the analysis of the data from the main experiment. An analysis of the decay of the average daily angular velocity in the 200-day period of observations is given. This decay is most likely due to eddy current and magnetic hysteresis torques. However, a distinct correlation between variations in these (estimated by computing the daily average of $\dot{H}^2$) and the measured damping torque is not completely clear. Any such correlation would be modulated by changes in the electrical and magnetic properties of the satellite components caused by variations in temperature. An analysis of the angular velocity fluctuation with a period of one orbital revolution is made. The oscillation is explained by the variation of the body's moment of inertia by thermal expansion and contraction because of periodic changes in the satellite's temperature caused by the passage of the satellite through the earth's shadow. Author

N65-15218*# Rochester U., N.Y.

THE ENERGY DEPENDENCE OF THE ABUNDANCE OF LITHIUM, BERYLLIUM, AND BORON IN THE PRIMARY COSMIC RADIATION: OBSERVATIONS AT FORT CHURCHILL

G. D. Badhwar, S. N. Devanathan, and M. F. Kaplon 13 Oct. 1964 40 p refs Partly supported by NASA
(GRANT AF-AFOSR-439-63)
(NASA-CR-60249; URPA-58) OTS: HC $2.00/MF $0.50

The relative abundance of lithium, beryllium, boron, and the S nuclei was determined at two different energies with the help of a pure nuclear emulsion stack ($\lambda = 70.5°$) on August 4, 1962 under a total of 4.7 g/cm^2 of residual atmosphere. The ratio of the L to S nuclei, at the top of the atmosphere between 200 to 700 MeV/n and > 700 MeV/n, was determined as 0.41 $\pm$0.08 and 0.19 $\pm$0.03, respectively. The results of both the absolute flux values of L and S nuclei, as well as their ratios, are in accord with other investigations. Combined with the evidence from the measurements of the ratio of He_3He in the same stack, our results indicate that low-energy cosmic-ray nuclei have traversed about twice as much hydrogen as high-energy particles. The results rule out an accelerating mechanism of the Fermi type but may be explained by a source-trapping mechanism. Author

N65-15223*# Arizona U., Tucson. Lunar and Planetary Lab.

COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 2, NUMBERS 31-35: MARS ISSUE

Gerard P. Kuiper, T. C. Owen, Dale P. Cruikshank, and James V. Marshall 1964 98 p refs
(Grant NsG-161)
(NASA-CR-60264) OTS: HC $3.00/MF $0.75

Four papers on the atmosphere of Mars and one on laboratory spectra of various gases are presented. In the first paper, spectra of the planet Mars obtained from the 82-in. telescope of the McDonald Observatory are presented for the interval 1μ to 2.5μ, and the spectra are examined for the presence of constituents other than CO_2. In the second paper, the Mars spectra reported in the first paper are calibrated with laboratory spectra of pure CO_2 and of mixtures of CO_2 with N_2 and Ar, and preliminary values are derived for the pressure of the Martian atmosphere and the total amount of gases other than CO_2. The third paper presents two independent determinations of the CO_2 content of the Martian atmosphere, derived from the Mt. Wilson plate obtained in 1964 by Kaplan, Münch, and Spinrad. The fourth paper presents laboratory spectra of the region 1μ to 2.5μ for testing the presence of CH_4, NH_3, N_2O, CO, and COS in planetary atmospheres. A new investigation of the reported presence of NO_2 in the Martian atmosphere is discussed in the fifth paper, and it is concluded that the upper limit on a vertical column of NO_2 on Mars is about 8 micron-atm. D.E.W.

N65-15284# Texas Instruments, Inc., Dallas.

TECHNIQUES FOR LUNAR WATER EXPLORATION Final Report

J. K. Westhusing and C. Crowe 30 Sep. 1964 529 p refs
(Contract AF 19(628)-3287)
(AFCRL-64-814; AD-608957)

Evaluation of technique applicability requires the formulation of models of the lunar subsurface and specification of lunar rock types and their possible mineralogic, chemical, and physical properties. Eight subsurface models and nine rock types are postulated. Lunar rock properties are estimated by evaluation of terrestrial rock measurements and possible modifications produced by lunar genesis and environment. Optimum combinations of surface and orbital methods are selected by comparing calculated or estimated survey responses across the models. Practical difficulties such as weight, power and volume restrictions, implanting of electrodes, and drilling are also considered. In practice, data obtained by combinations of methods should be interpreted simultaneously to assure definition of a geologic or structural explanation applicable to all data. The methods recommended for orbital reconnaissance and surveying are phototelevision, infrared, radar altimetry and magnetic. Those recommended for surface exploration are gamma ray, television, infrared, gravity, magnetic, and electromagnetic. Comprehensive data concerning all equipment types considered are presented. Author

N65-15288# Lowell Observatory, Flagstaff, Ariz.

PHYSICAL RESEARCHES ON THE BRIGHTER PLANETS Final Report

William M. Sinton 30 Sep. 1964 20 p refs
(Contract AF 19(604)-5874)
(AFCRL-64-926; AD-609547)

Observational studies of the planets and the moon through the use of photography, photoelectric photometry, infrared radiometry, and infrared spectroscopy were made. The resulting data include the measurements of the thickness of dust on

the floors of 16 lunar craters; the infrared radiometric temperatures of Mercury, Venus, Mars, Jupiter, Saturn, and Uranus; and extensive photoelectric photometry of Mars. Some of the important conclusions that have been previously published are included. Author

N65-15300# Air Weather Service, Washington, D.C.
METEOROIDS AND THEIR EFFECT ON AEROSPACE SYSTEMS
Robert F. Long 15 Oct. 1964 59 p refs
(Rept.-4WGP-80-5-1; AD-450481)

This pamphlet summarizes current knowledge of the meteoroid environment and the meteoroid flux. These meteoroid data are then combined with hypervelocity impact theory to present engineering estimates of the probable meteoroid hazard to aerospace systems. Author

N65-15325*# Cook Electric Co., Morton Grove, Ill. Tech-Center Div.
A PARACHUTE DESIGN STUDY FOR A MARS ENTRY VEHICLE
R. D. Turner Sep. 1964 141 p Prepared for JPL
(Contracts NAS7-100; JPL-950741)
(NASA-CR-60290; FR-3707B) OTS: HC $4.00/MF $1.00

The study was to define an optimum system which would provide the maximum deployment altitude, minimum terminal velocity and maximum descent time consistent with practical weight limitations. The basic entry vehicle weight considered was 350 lb which included 100 lb for the sum of the payload and second-stage parachute. The success of recent high supersonic parachute tests allowed consideration of supersonic deployment Mach numbers. The optimum system was found to be a 12-ft projected diameter Hyperflo parachute for first stage deceleration and a 59.3 ft nominal diameter extended skirt parachute for the terminal stage. The first stage deployment Mach number chosen for this system was 3.0. The total parachute system weight was estimated to be 54 lb or 15.4% of the entry vehicle weight. This optimum parachute system's performance was investigated for entry angles between −90° and −20° for several atmospheric profiles, and for a range of entry velocities. For entry vehicles weighing more than 350 lb (up to 5000 lb) the ratio of total parachute weight to entry vehicle weight exceeded the 10% obtained for the 350 lb vehicle. The scaling used in determining the sizes of parachutes for the higher entry vehicle weights was based on maintaining the same ballistic coefficient for each stage of deceleration, thereby maintaining the same terminal velocity. Author

N65-15357# National Academy of Sciences-National Research Council, Washington, D.C. Space Science Board
BIBLIOGRAPHY ON SPACE SCIENCES (UNITED STATES–1960)
Apr. 1961 74 p refs Revised Supersedes Bibliog. in append. V of U.S. Space Sci. Program: Rept. to COSPAR, Florence, Apr. 1961

N65-15370*# AVCO-Everett Research Lab., Everett, Mass.
THE SPECTRUM OF SHOCK-HEATED GASES SIMULATING THE VENUS ATMOSPHERE
A. Fairbairn Jul. 1963 15 p refs Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmosphere, Cambridge, Mass., 26–28 Aug. 1963
(Contract NASw-748)
(NASA-CR-51668; AVCO-Everett Res. Note-371) OTS: HC $1.00/MF $0.50

Mixtures of 90% N_2 plus 10% CO_2, and 80% N_2 plus 20% CO_2 were heated by reflected shock waves to temperatures of about 8000° K and normal density. Photographic and photoelectric measurements were made of the emitted radiation in the region 0.23μ to 1.2μ. The CN radical is the most prominent radiator in these experiments, and the intensity of the emission may be used to derive transition probabilities for the violet and red systems of bands. Author

N65-15401*# Chrysler Corp., Detroit, Mich. Missile Div.
STUDY IN MULTIVARIATE APPROXIMATIONS FOR STEERING AND OTHER CONTROL FUNCTIONS IN SPACE/FLIGHT OPERATIONS OF SATURN TYPE VEHICLES Final Report
R. J. Vance Nov. 1964 20 p refs
(Contract NAS8-11049)
(NASA-CR-60351; AM-TR-2-64) OTS: HC $1.00/MF $0.50

An implementation of the path adaptive guidance mode involves the generation of a manifold of precalculated optimal trajectories through a numerical solution of the Euler–LaGrange equations, followed by approximations of the control variables as functions of the state variables. These approximations, typically, are restricted to polynomials and/or ratios of polynomials. The Gram–Schmidt orthonormalization process has been described in previous reports as an efficient procedure for the generation of these approximations. The studies described in this final report pertain to several problems arising in the general approximation process and to a treatment of the guidance and control problem as a stochastic process. The latter study introduces several concepts of stability for the Euler–LaGrange system of differential equations. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-14497# Wolf Research and Development Corp., West Concord, Mass.
CALIBRATION SATELLITE STUDIES 64-3897-6 Final Report
M. Richard Harris, Harry R. Kahler, Gerald A. Quellette, and John F. Pasieka 22 Oct. 1964 56 p refs
(Contract AF 19(628)-3897)
(AFCRL-64-873; AD-609041)

Described are the results of the mathematical and systems engineering investigations pertaining to the calibration of range instrumentation by means of a calibration satellite. These studies are based on the premise that the instrumentation systems to be calibrated using such a satellite are the MISTRAM and GLOTRAC cw systems and the C-Band and S-Band pulse radar systems. It was further defined that the basic vehicle to carry the calibration payload would be the SATAR (Satellite for Aerospace Research). The capabilities of SATAR do not allow the simultaneous inclusion of transponders compatible with all the above systems on one vehicle. These studies have preserved flexibility in techniques within these constraints. Author

N65-14725# Boeing Co., Seattle, Wash. Aero-Space Div.
STUDY OF EARTH ATMOSPHERIC ENTRY TESTS OF PLANETARY ENTRY SYSTEMS
Dec. 1964 119 p refs
(D2-23294)

This study examines the many development phases of a space vehicle program and identifies those test objectives that can best be met through an earth-atmospheric test program. Detailed requirements are established and an integrated test program is formulated for each objective; the capabilities of various boost systems and test ranges are evaluated, and program costs, in terms of required personnel, facilities, and boosters, are estimated. In general, the test hardware will comprise a launch system and test spacecraft. Initially, the test profile will consist of a near-vertical trajectory from a ground station until the desired altitude is attained. The launch vehicle, minus expended stages, will then be rotated to the desired entry angle and the spacecraft payload accelerated toward the surface to attain the desired atmosphere entry velocity. M.G.J.

N65-14785*# National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH FIRST 'CARTWHEEL' WEATHER SATELLITE, TIROS I (EYE) News Release No. 65-7
19 Jan. 1965 20 p
Available from the Scientific and Technical Information Division

The first cartwheel-type weather satellite, TIROS I (eye), is designed to roll along its near-polar orbit at a rate of 10 revolutions a minute. Cameras in its rim will view the Earth once each revolution, permitting daily photographing of the entire sunlit portion of the earth. The Delta launch vehicle has been scheduled to put the 305-pound satellite into a circular orbit 460 statute miles high, inclined 81.6° to the equator, with an orbital period of 100 minutes. When TIROS I becomes operational, it will be redesignated TIROS IX. Statistics on the technical background flight plan, sunsynchronous polar orbit, spacecraft configuration and systems, stabilization and control subsystems, the Delta launch vehicle, and the record of preceding weather satellites are given, along with a list of project officials. M.G.J.

N65-14804*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR, MISSION A. SPACE FLIGHT OPERATIONS PLAN
W. F. Eichwald and J. F. Gautschi 7 Dec. 1964 234 p
(Contract NAS7-100)
(NASA-CR-60121; EPD-180, Rev. 2) OTS: HC $6.00/MF $1.50

Space flight operations are defined as the operations necessary for obtaining and processing spacecraft information and for determining and executing spacecraft commands from launch to the accomplishment of the mission. This space flight operations plan covers the requirements for Surveyor Mission A. Operational facilities and support equipment are described, and the flow of data between facilities is outlined. Required sequences and procedures are specified for the standard case and for certain nonstandard situations. Author

N65-14847* National Aeronautics and Space Administration, Washington, D.C.
UNITED STATES LAUNCH VEHICLES FOR PEACEFUL EXPLORATION OF SPACE NASA Facts, Volume II, No. 5, Supplement
1964 1 p
GPO: $0.25

This chart, intended as an educational display, presents drawings, dimensions, and general characteristics of the main basic U.S. launch vehicles. Also included are diagrams and explanations of the combustion process in liquid propulsion, the thrust weight diagram of a launch vehicle, Saturn manned space-flight engines, the solid-propellant rocket, and two versions of liquid-propellant rockets. D.S.G.

N65-15040*# National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH SOLAR OBSERVATORY FROM CAPE KENNEDY. PROJECT OSO-B2 News Release No. 65-14
20 Jan. 1965 35 p
Available from the Scientific and Technical Information Division

An orbiting solar observatory will be launched in February 1965 by NASA. This spacecraft will carry out eight experiments designed to study X-rays, gamma rays, and ultraviolet radiation to advance the understanding of the Sun's structure and behavior, and to determine the physical processes by which the Sun influences the Earth. G.G.

N65-15053*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AC-4 ATLAS-CENTAUR FLIGHT EVALUATION (LAUNCHED DECEMBER 11, 1964)
Washington, NASA 1964 181 p
(NASA-TM-X-52078) OTS: HC $5.00/MF $1.25

The AC-4 launch vehicle was launched on an azimuth of 105° East of true North and was programed to a flight azimuth of 102.5° East of true North. The first burn of Centaur main engines injected the Centaur 4C and the Surveyor mass model into a near perfect 90 n.mi. circular orbit (94.92 n.mi. apogee altitude, 88.20 n.mi. perigee altitude). First look at data indicates a near nominal flight path indicating that the closed-loop guidance system functioned properly. The AC-4 launch vehicle was the first in the Centaur series with restart capabilities. Centaur main engine restart (secondary objective) was programed to take place after an approximate 15-minute coast period in the nominal 90 n.mi. circular orbit; however, restart of the main engines did not occur due to tumbling of the Centaur; tumbling started at about MECO + 4.50 minutes. Although second burn was not achieved, the guidance system continued to function properly to the end of the programed flight. An attempt to recover the nose fairing was made but neither the nose fairing nor insulation panels was recovered. Author

N65-15073# McGill U., Montreal (Canada). Space Research Inst.
OUTLINE AERODYNAMICS & PERFORMANCE OF THE MARTLET 2C
F. W. Eyre Nov. 1964 23 p
(SRI-H-TN-1)

The predicted basic aerodynamic data pertinent to the Martlet 2C vehicle are presented, as well as its performance

data as a function of the major parameters. The combination of weight and muzzle velocity necessary to meet a 125-km specification are presented, together with center of gravity tolerance. The standard TMA vehicle at 182-lb all-up-weight achieves this specification at a launch muzzle velocity of 6000 fps. The rearmost center of gravity location tolerable for any version is 22 in. from the body base. R.R.D.

N65-15177 Joint Publications Research Service, Washington, D.C.
MATHEMATICAL THEORY OF ROCKET FLIGHT
Chih-chiang Yeh *In its* Transl. on Communist Chinese Sci. and Technol., No. 133 8 Jan. 1965 p 1–15 refs Transl. into ENGLISH from Shu-hsueh T'ung-pao, (Peiping), no. 8, 1964 p 38–43 (See N65-15176 05-34) OTS: $2.00

The differential equation of rocket motion is derived, and Tsiolkovski's first and second problems are discussed. The problems of rocket flight near the earth's surface are considered, and a formula for an optimum rocket flight plan is derived. D.E.W.

N65-15215# Joint Publications Research Service, Washington, D.C.
MANNED SPACE STATIONS
I. N. Bubnov and L. N. Kamanin 21 Jan. 1965 159 p refs Transl. into ENGLISH of the book "Obitayemyye Kosmicheskiye Stantsii" Moscow, 1964 p 1–189
(JPRS-28390; TT-65-30171) OTS: $5.00

CONTENTS:
1. MAN IS IN SPACE, BUT WHAT NEXT p 1–12
2. WHAT IS THE NEED FOR MANNED SPACE STATIONS p 13–37
3. ORBITS, ROCKETS AND ORBITING SPACE STATIONS p 38–87
4. PROLONGED LIFE IN ORBIT p 88–118
5. ELECTRICITY IN SPACE p 119–140
6. FROM PROBLEMS TO PROJECTS p 141–160

N65-15253*# National Aeronautics and Space Administration, Washington, D.C.
LAUNCH VEHICLES
[1964] 1 p
(NASA Facts, Vol. II, No. 5) GPO: $0.15

Described are the launch vehicles currently being used in the NASA space program. Scout is used for small satellite missions, high-altitude probes, and reentry experiments. Delta is used for a wide range of small payload satellite missions. Thor-Agena B is used with Orbiting Geophysical Observatory (OGO) and the Echo II communications satellite. Atlas-Agena B is used for large earth satellites, lunar probes, and interplanetary and planetary exploration craft. Titan is the vehicle for the Gemini program. Atlas-Centaur will launch unmanned lunar and planetary missions, and has capabilities that are suitable for high-velocity interplanetary probes. Saturn I will launch unmanned Apollo spacecraft on earth-orbital test flights. Saturn IB has the same booster as Saturn I, but has more thrust in the second stage. Saturn V is the vehicle for the manned lunar landing mission. R.R.D.

N65-15276# Mitre Corp., Bedford, Mass.
VULNERABILITY OF MANNED ORBITAL COMMAND POSTS TO NATURAL SPACE RADIATIONS
F. W. French and K. F. Hansen Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1964 82 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-164; TM-04073; AD-609501)

The shielding requirements for the protection of the crew of a manned orbital command post against the natural radiations are investigated. Two types of orbits of military importance and of wide applicability are considered—a long-duration, high-altitude orbit above the Van Allen Belt and a short-duration, low-altitude polar orbit below it. Model environments for both orbits in terms of solar flare, cosmic, and Van Allen Belt radiations are postulated. Radiobiological tolerance criteria are investigated, and a somewhat unique criterion, based on partial recovery of sustained somatic damage, is proposed for the long duration mission. A mathematical description of the radiation transport of the separate environmental components through the radiation shield is formulated. Appropriate simplifications are used to obtain expressions for the doses due to primary protons, secondary protons and neutrons, and bremsstrahlung. Calculations are carried out on the IBM 7030 computer to obtain dose vs thickness curves for different types and amounts of shielding material. These curves, together with the assumed model environment, and the postulated radiobiological tolerance criteria, are used to calculate minimum shielding thicknesses for both types of orbits. Conclusions are then drawn on the total amount of radiation shielding material that must be carried for each orbit. Author

N65-15333*# Goodyear Aerospace Corp., Akron, Ohio. Astronautics Design Dept.
DEVELOPMENT OF MATERIALS FOR SATURN FLEXIBLE HEAT SHIELD CURTAINS AND TAIL SECTION INSULATION Final Report, 17 Jan. 1962–17 Dec. 1964
R. J. French 17 Dec. 1964 148 p refs
(Contract NAS8-2564)
(NASA-CR-60298; GER-11814) OTS: HC $4.00/MF $1.00

Development of a flexible heat shield and of a trowelable insulation material for the Saturn V vehicle is documented in this report, along with an evaluation of flexible materials for fabricating an entire firewall bulkhead. Each project included a literature survey, screening tests of candidate materials, their selection and testing, the development of parameters, and the technical approach taken. Two flexible heat shield prototypes have been successfully constructed to meet requirements, but due to the difficulty of simulating reentry conditions, final tests will await installation on the Saturn V. A trowelable mortar has been developed from a very lightweight, unfired ceramic insulation, employing a room temperature-curing inorganic bond. It is adaptive to either adhesive or mechanical attachment to the metal substrate, and has low thermal conductivity. Based on these results, a feasibility study was undertaken to evaluate their potential application to an entire firewall bulkhead, and several recommendations for extended research are made. M.G.J.

N65-15338*# National Aeronautics and Space Administration, Washington, D.C.
NIMBUS
[1964] 1 p ref
(NASA Facts, Vol. II, No. 7) GPO: $0.15

Nimbus I demonstrated the feasibility of a 24-hour-a-day global weather watch by satellite. Weighing 830 pounds, the Nimbus I extends 12 feet from its circular base to the tip of its command antenna. It has a span of 11 1/6 feet across its two solar paddles. The main spacecraft body measures 4 3/4 feet in diameter at the base and 10 feet in height.

Nimbus I provided the first pictures of the earth's surface and of cloud patterns ever taken by a weather satellite at night. NASA's global Satellite Tracking and Data Acquisition Network tracks Nimbus and provides orbital predictions. This information is funneled to the Nimbus Technical Control Center and is processed by the Nimbus Data Handling Facilities at Goddard Space Flight Center. R.R.D.

N65-15345# Rome U. (Italy). Aerospace Research Center
CONSIDERATIONS ON THE DRAG COEFFICIENT FOR THE SAN MARCO SATELLITE
Carlo Buongiorno and Massimo Trella Jul. 1964 35 p refs *Its* Atti No. 5

The evaluation of the atmospheric density from the drag measurements of the San Marco satellite is based on the possibility of an a priori knowledge of the drag coefficient. The available information on the contributions due to the aerodynamic, radiation, and electric forces are critically reviewed in order to define the degree of accuracy in the prediction of the C_D and, consequently, the expected possible error in the ρ_∞. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-14479# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
THE STRESSES IN A CYLINDRICAL SHELL CONTAINING AN AXIAL CRACK
Efthymios S. Folias Wright-Patterson AFB, Ohio, ARL, Oct. 1964 50 p refs
(Contract AF 33(616)-7806)
(ARL-64-174; AD-609669)

Using an integral formulation, the coupled Marguerre equations for a cracked cylindrical shell of length 2c are solved for the in-plane and Kirchhoff bending stresses, and it is found that the explicit nature of the stresses near the crack point depends upon the inverse half-power of the nondimensional distance from the point ϵ. The character of the combined extension–bending stress field near the crack tip is investigated in detail for the special case of an axial crack in a long closed cylindrical shell which is subjected to uniform internal pressure q_0. Pending a complete study of the solution, approximate results for the combined surface stresses near the crack tip normal and along the line of crack prolongation are respectively of the form:

$$\sigma_y(\epsilon,0)\Big|_{\nu=1/3} \approx \frac{0.79}{\sqrt{2\epsilon}}\frac{q_0 R}{h} + \ldots$$

and similarly

$$\sigma_x(\epsilon,0)\Big|_{\nu=1/3} \approx -\frac{0.97}{\sqrt{2\epsilon}}\frac{q_0 R}{h}.$$

Author

N65-14482# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences
STUDIES OF SHIP ROLL STABILIZATION TANKS
John F. Dalzell, Wen-hwa Chu, and J. Everett Modisette Aug. 1964 68 p refs
(Contract Nonr-3926(00))
(TR-1; AD-607765)

This report summarizes the background to and development of a quasi-linear theory for rectangular type antirolling tanks, and presents results of the ensuing experimental investigation. Both theoretical and experimental methods are described, and comparisons between theory and experiment are made. It was found that though the initial theoretical method reflects the gross behavior of the fluid in the tank and the moments exerted on the ship, it should be regarded as the basis on which to build a better understanding rather than as a design technique. Experimental findings also indicate that the antiroll tank is a nonlinear control element over its practical range of operation. It is recommended that a nonlinear mathematical representation be developed which incorporates empirical results as necessary. Author

N65-14483# Stanford U., Calif.
THE EFFECT OF THE EDGE CONDITIONS ON THE BUCKLING OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION
Nicholas J. Hoff Aug. 1964 21 p refs Presented at the 11th Intern. Congr. of Appl. Mech., Munich, 30 Aug.–5 Sep. 1964
(Contract AF 49(638)-1276)
(SUDAER-205; AFOSR-64-1724; AD-608203)

A summary is presented of recent closed-form as well as numerical solutions of the buckling problem of thin-walled circular cylindrical shells subjected to uniform axial compression. The ratio of the critical stress to the classical value of the critical stress was calculated for nine different combinations of boundary conditions. The minimal values of the buckling stress ratios are 1 for rigid end fixation and 0.5 for simple supports, while in the case of free ends the buckling stress ratio can be very small. The large effect on the buckling stress of small changes in the boundary conditions is proposed as one of the reasons for the large scatter in the results of buckling experiments. Author

N65-14484# Stanford U., Calif.
BUCKLING OF CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION
Nicholas J. Hoff and Tsai-chen Soong Aug. 1964 76 p refs
(Contract AF 49(638)-1276)
(SUDAER-204; AFOSR-64-1725; AD-608204)

The buckling stress of axially compressed thin-walled circular cylindrical shells of finite length is derived from the classical small-deflection equations for nine possible combinations of edge support conditions. The effect upon the critical stress of the length-to-diameter ratio of the shell is small except in some cases when the shell is very short. Changes in the details of the edge support can lead to reduction factors of 1/2 or less to be applied to the classical value σ_{cl} of the critical stress. The reduction factors $\rho = \sigma_{x0}/\sigma_{cl}$, where σ_{x0} is the axial stress that causes buckling under the edge conditions specified, are plotted in a number of diagrams against the reduced length $2L^*/\sqrt{ah}$ of the cylinder, where $2L^*$ is the length, a is the radius of the middle surface, and h is the wall thickness. Figures showing the various buckled shapes are presented. Author

N65-14542# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF ACADEMY OF SCIENCES USSR, TECHNOLOGY SECTION, MECHANICS AND MECHANICAL ENGINEERING Selected Articles

27 Jan. 1964 41 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk. Mekhan. i Mashinostr. (Moscow), no. 4, 1961 p 83–103
(FTD-MT-63-135; AD-605705) OTS: $2.00

CONTENTS:

1. NONLINEAR FLUTTER OF AIRCRAFT WING DURING FLIGHT IN BUMPY AIR V. V. Babykin and Yu. M. Romanovskiy p 1–2 refs (See N65-14543 05-32)

2. STABILITY OF ORTHOTROPIC PLATES AROUND WHICH FLOWS A SUPERSONIC FLOW OF GAS S. A. Ambartsumyan and Zh. Ye. Bagdasaryan p 15–24 refs (See N65-14544 05-32)

3. FORCED NONLINEAR OSCILLATIONS OF ELASTIC PANELS G. V. Mishenkov p 25–35 refs (See N65-14545 05-32)

N65-14543 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR FLUTTER OF AIRCRAFT WING DURING FLIGHT IN BUMPY AIR
V. V. Babykin and Yu. M. Romanovskiy *In its* News of Acad. of Sci. USSR, Technol. Sect., Mech. and Mech. Eng. 27 Jan. 1964 p 1–2 refs (See N65-14542 05-32) OTS: $2.00

The effect of dry friction in the hinge of an aileron on oscillations of an elastic wing during flight of an aircraft in bumpy air was studied. Developed are equations for the flexural oscillations of a wing with an aileron in the presence of turbulent flow. Considered are flexural aileron oscillations (1) in the absence of external influences, (2) under the influence of gusts of definite form, and (3) under the continuous influence of atmospheric turbulence. P.V.E.

N65-14544 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF ORTHOTROPIC PLATES AROUND WHICH FLOWS A SUPERSONIC FLOW OF GAS
S. A. Ambartsumyan and Zh. Ye. Bagdasaryan *In its* News of Acad. of Sci. USSR, Technol. Sect., Mech. and Mech. Eng. 27 Jan. 1964 p 15–24 refs (See N65-14542 05-32) OTS: $2.00

Considered is the problem of nonlinear flutter of an orthotropic rectangular plate, around which flows a supersonic flow of gas. An attempt is made to determine the influence of transverse motion on the characteristic of flutter. The problem is solved approximately in nonlinear placement with the help of variable methods. Author

N65-14545 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORCED NONLINEAR OSCILLATIONS OF ELASTIC PANELS
G. V. Mishenrov *In its* News of Acad. of Sci. USSR, Technol. Sect., Mech. and Mech. Eng. 27 Jan. 1964 p 25–35 refs (See N65-14542 05-32) OTS: $2.00

The problem of forced oscillations of an elastic hollow cylindrical panel by the variational method is reduced to an ordinary nonlinear differential equation. Periodic solutions of this equation are determined, and their stability is investigated. Examined in detail is the case of a system which has two stable positions of equilibrium (this corresponds to a panel loaded by longitudinal forces exceeding the lower critical value). Several periodic motions are pointed out which can be realized during corresponding nonzero initial conditions. Various cases showing dependence of oscillations on the "history" of the system are discussed. Author

N65-14574# Pennsylvania State U., University Park.
PLUG FORMATION IN PLATES Interim Technical Report
H. R. Minnich and Norman Davids 1 Sep. 1964 48 p refs
(Contract DA-31-124-ARO(D)-67)
(ITR-3; AD-452043)

A computer approach has been developed for determining the impact yield strength in the intermediate state, below which target material may be assumed quasi-rigid, and above which viscous shear flow takes place. Reasonable numerical values of the impact yield constant and the viscosity coefficient of the plate material have been obtained by comparing the computed vertical shear stress, velocity, and displacement profiles with photographs of etched specimens of plate subjected to impact. In developing the program, two dynamical laws (rigid-viscous material behavior, and impulse momentum) have been incorporated directly into the program logic. M.G.J.

N65-14631*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
STRESS-INTENSITY FACTORS FOR SINGLE-EDGE-NOTCH SPECIMENS IN BENDING OR COMBINED BENDING AND TENSION BY BOUNDARY COLLOCATION OF A STRESS FUNCTION
Bernard Gross and John E. Srawley Washington, NASA, Jan. 1965 17 p refs
(NASA-TN-D-2603) OTS: HC $1.00/MF $0.50

A boundary-value-collocation procedure was used in conjunction with the Williams stress function to determine values of the stress-intensity factor K for single-edge cracks of various depths in specimens subjected to pure bending. The results are of use in connection with K_{Ic} crack toughness tests, which utilize rectangular-section crack-notch beam specimens loaded in four-point bending, and are in good agreement with published results derived from experimental compliance measurements. The results are expressed in convenient, compact form in terms of the dimensionless quantity $Y^2 = K^2B^2W^3/M^2$, which is a function of relative crack depth a/W only, where B and W are the specimen width and thickness and M is the applied bending moment. Author

N65-14662# Wayne State U., Detroit, Mich.
INVESTIGATION OF VIBRATION REDUCTION IN ROCKET MOTORS Final Research Report
Harold George Donnelly Feb. 1964 42 p
(Contract DA-20-018-ORD-22756)
(AD-450817)

A heat-resistant elastomer mixture was acquired and shown to absorb about twice as much acoustic energy when heated with an oxyacetylene torch flame as when not heated. Various elastomeric mixtures that are used in rockets or are about to be used were also tested and shown to absorb around twice as much acoustic energy when heated as compared to the amount absorbed when not heated. Burning solid propellant absorbs incident acoustic energy about the same as heat resistant elastomers heated by an oxyacetylene torch flame. About 7 seconds after the solid propellant is completely burned, a surface is formed that absorbs most of the incident acoustic energy. The method of operation and the necessary calculations are described. Author

N65-14805*# Michigan U., Ann Arbor. Coll. of Engineering
VIBRATIONS AND STABILITY OF BUCKLED RECTANGULAR PLATES
Yao W. Chang and Ernest F. Majur Oct. 1964 83 p refs
(Grant NsG-132)
(NASA-CR-60120) OTS: HC $3.00/MF $0.75

Linearized vibrations of a rectangular plate relative to a static buckled configuration and the instability of the buckling modes are reported. Both the static and dynamic equations of equilibrium are solved by perturbation techniques. If perturbation coefficients up to the third order are included, results are acceptable for a significant range of the loading parameter. For large values of the latter, the vibration frequency of the plate is obtained by the Galerkin method, while the static problem is solved by a method similar to the Marguerre approach. M.G.J.

N65-14929*# Midwest Applied Science Corp., Lafayette, Ind.
OPERATION MANUAL FOR SPHERICAL SHELL PROGRAM
John E. Goldberg and Dale W. Alspaugh Mar. 1964 23 p *Its* Rept.-64-4
(Contract NAS8-1674)
(NASA-CR-60103) OTS: HC $1.00/MF $0.50

Theoretical aspects of the analysis and the numerical techniques used to find stresses and displacements in spherical shells are covered in a previous report. This supplement provides detailed instructions for the preparation of data for the computer program for those with no prior knowledge of FORTRAN. The system described is designed for a high-speed digital computer with 32k core storage capacity and at least two auxiliary tape units in addition to input and output tapes. E.E.B.

N65-14930*# McGill U., Montreal (Canada). Space Research Inst.
THE INITIAL ONE-DIMENSIONAL EXPANSION OF THE SHOCKED STATES GENERATED BY THE IMPACT OF CYLINDRICAL PELLETS WITH THIN PLATES Topical Report
Frank J. Zwarts 15 Jan. 1965 98 p refs
(Contract NAS3-4190)
(NASA-CR-54209; TN-64-6) OTS: HC $3.00/MF $0.75

A theoretical investigation of the hypervelocity impact of pellets with thin plates has been performed. Some of the experimental work on the determination of shocked states has been reviewed and incorporated into a purely one-dimensional model of the impact phenomena. Based on this model, a computer program was developed using a finite difference technique based on the method of characteristics in order to calculate the one-dimensional system of interacting waves. An arbitrary equation of state could be used. Using this program, various equations of state were examined as to their relative merits in describing the dynamics of the expansion process. Especially the ideal gas approximation was critically examined and found to be applicable at high impact velocities. Upstream flow was calculated and its dependence on impact velocity and bumper material was analyzed. Author

N65-14976# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
ON THE NUMERICAL ANALYSIS OF THE NONLINEAR AXISYMMETRIC EQUATIONS FOR SHELLS OF REVOLUTION
John F. Mescall Oct. 1964 22 p refs
(AMRA-TR-64-20; AD-453459)

A numerical procedure for obtaining solutions to the nonlinear equations for shells of revolution is described and applied to the problem of a spherical shell under a concentrated load at the apex. Boundary conditions corresponding to an unrestrained edge and a clamped edge are examined, and the results are compared with available experimental data. Author

N65-15005# Suffield Experimental Station, Ralston, Alberta (Canada).
BLAST LOADING ON SIMPLE RIGID SHAPES BY A 100-TON TNT SURFACE BURST EXPLOSION
D. J. Kempster and J. M. Dewey 2 Dec. 1964 29 p refs
(Suffield-TN-81)

An attempt was made to measure the blast loading on several cylindrical and spherical structures by means of piezoelectric gages flush mounted in their surfaces. The unreliability of the piezoelements has permitted the derivation of only a limited amount of information. Author

N65-15018*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
GRAVITY GRADIENT ROD THERMAL BENDING TEST REPORT, SUPPLEMENT
W. G. Benton, E. M. Mazur, and R. J. Katucki 4 Dec. 1964 17 p *Its* Doc.-65SD4205
(Contract NAS2-1946)
(NASA-CR-60129) OTS: HC $1.00/MF $0.50

Thermal-bending tests were performed in a liquid-nitrogen cooled vacuum bottle containing a test rod with thermocouples and a tungsten wire as the heat source. The temperature variations around the circumference of the test rod were observed and compared to the predicted variations, and the α_{IR} of the rod material was experimentally determined. The actual measured thermal differences were about 46 percent below the predicted values. G.G.

N65-15138*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AC DEMAGNETIZATION OF SATELLITE COMPONENTS
John D. Watson [1963] 7 p refs *In* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environment, 18 Jun.–18 Sep. 1963, NASA-TM-X-55015; X-320-63-264 (See N64-28201 20-23)
(NASA-TM-X-54944; NASA-TM-X-55015; X-320-63-264) OTS: HC $1.00/MF $0.50

A tumbling system was designed and built to provide random motion of a satellite component within an imposed magnetic field. Samples were first magnetized and then demagnetized with the tumbler or with an apparatus for dc deperming. Initial tests indicate ac tumbling is more effective than dc deperming, that tumbling of the component is an important factor in the demagnetization process, and that a field-free space, although certainly helpful, is not a major requirement for demagnetization by ac tumbling. D.E.W.

N65-15142*# Northrop Space Labs., Hawthorne, Calif.
METEOROID PENETRATION DISTRIBUTED TRANSDUCER Final Report
Martin J. Gould Nov. 1964 314 p refs
(Contract NAS8-5336)
(NASA-CR-60199; NSL-63-149-13) OTS: HC $7.00/MF $1.75

An evaluation is described of the potential usefulness of piezoelectric transducers for sensing impact parameters of micrometeoroids in space, such as mass, velocity, density, momentum, or energy. The approach used attempted to relate impact parameters to transducer output characteristics so that, by recording the output of the transducer before it shatters, information is gained not only about the existence of an impact and perhaps a penetration, but also about the mass, velocity, etc., of the colliding particle. Results of experiments with target plates preceding the transducers and with high velocity shots into PZT or quartz transducers are reported. D.E.W.

N65-15159*# National Aeronautics and Space Administration, Washington, D.C.
STABILITY OF INCLINED, DOUBLE-CURVATURE SHELLS ON A RECTANGULAR SURFACE [KUSTOYCHIVOSTI POLOGIKH OBOLOCHEK DVOYAKOY KRIVIZNY NA PRYAMOUGOL'NOM PLANE]
B. S. Vasil'kov and L. S. Minayev Jan. 1965 12 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 3, 1964 p 566–570
(NASA-TT-F-9236) OTS: HC $1.00/MF $0.50

The stability of inclined, thin shells having double curvature and resting on a rectangular surface is investigated, using the method of Bubnov–Galerkin. The stability of spherical shells under normal pressure and of shells with frequent supports is investigated. Author

N65-15174# Battelle Memorial Inst., Columbus, Ohio.
THERMAL PROPERTIES OF HIGH-TEMPERATURE MATERIALS
W. D. Wood and H. W. Deem Huntsville, Ala., Army Missile Command, 1 Jun. 1964 405 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-202; AD-455069)

This report is a compilation of specific-heat, thermal-expansion, and thermal-conductivity data for materials of possible structural usefulness above 2500° F. Data are presented graphically with notations as to measurement methods and test conditions. Prominent laboratories currently making thermal-property measurements are identified. Author

N65-15198# IIT Research Inst., Chicago, Ill.
EVALUATION AND ANALYSIS OF CENTRAL FIRING STATION OF WES LARGE BLAST LOAD GENERATOR
A. Longinow Jul. 1964 147 p refs *Its* Contract Rept. No. 1–90
(Contract DA-22-079-ENG-363)
(AD-450954)

This evaluation of the design and structural load integrity of the central firing station for blast load generator includes a design review, a static analysis of shear deformations of pertinent parts, and a gross dynamic analysis with emphasis on the behavior of the pile foundation. A modal analysis of the central firing station as an elastic frame under dynamic loading was performed and the results were compared to experimental data derived from load cells during static and dynamic tests within the generator. A satisfactory agreement between theoretical and experimental data was observed, and the distribution of post-tensioning rods within the structure, their size and magnitude of induced stress, were determined as a direct result of this study. G.G.

N65-15222*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
A PROCEDURE IN THE DESIGN OF SPHERICAL DOMES
Rolland G. Sturm Jul. 1964 54 p
(Contract NAS8-5289)
(NASA-CR-60267; R-109) OTS: HC $3.00/MF $0.50

This study discusses the merits of three types of spherical domes. A design procedure which generally applies to all types is given in step-by-step form for one type of spherical dome. Mathematical expressions are given without detailed derivation but with reference to sketches from which the derivations can be developed. Author

N65-15272# Toronto U. (Canada). Inst. for Aerospace Studies
AN EXPERIMENTAL INVESTIGATION OF THE BUCKLING OF CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION USING THE PHOTOELASTIC TECHNIQUE
R. C. Tennyson Nov. 1964 170 p refs Sponsored by the Defence Res. Board of Canada
(UTIAS-102)

Five accurately made, homogeneous, isotropic cylindrical shells of circular cross section ($100 \leq R/t \leq 180$, $2.0 \leq L/R \leq 5.0$) were tested in axial compression and found to buckle completely elastically within 10% of the classically predicted values. This represents an increase over previous experimental data. All shells were made from photoelastic plastic, and results were repeatable. An experimental shell stress analysis was performed making use of the birefringence property of the shells. Intermediate and inner reflective surfaces permitted the separation of the principal membrane and bending stresses. Experimental evidence of the unstable states occupied by the shell during the snap-through buckling process was obtained by photographing the change in the 45° isoclinic patterns. Analysis indicates that the shell initially buckles with a wave shape similar to the classical waveform, which rapidly degenerates into the diamond-shaped buckle in about 0.005 seconds. Author

N65-15316# General Dynamics/Fort Worth, Tex.
STUDIES OF MAGNETIC SHIELDING AND SUPERCONDUCTIVITY
J. M. Norwood and F. L. Gibbons 4 Nov. 1963 52 p refs
(Contract AF(657)-11214)
(ERR-FW-210; AD-423178)

Theoretical considerations of magnetic (active) shielding of space vehicles against charged-particle cosmic-radiation indicate inadequate treatment in feasibility studies. Simplified expressions for the magnetic vector potential lead to predictions of possibly fictitious, completely shielded regions. The mathematical model presented herein avoids this deficiency, and a method of determining the completely shielded regions is developed. Experimental investigations establish the capability of winding superconducting solenoids and making junctions between superconducting wire and current-carrying leads. Junctions made by spot welding superconducting Nb-Zr wire to copper electrodes, including foil, prove to be superior in reliability, simplicity, and high current capacity. Critical currents in three superconducting solenoids, constructed to operate at 10-, 15-, and 22-kG, were lower than those measured in short segments by amounts consistent with data in available literature. Persistent currents were established in two of the solenoids. Author

N65-15322# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MEMBRANE AND BENDING STRESSES IN SHALLOW, SPHERICAL SHELLS
F. Y. M. Wan 11 Aug. 1964 46 p refs
(TR-317; AD-607457) OTS: $2.00

The present work is concerned with the nature of the interior solution and the influence coefficients of shallow, spherical, thin, elastic shells (or equivalently a shallow, thin, elastic, paraboloidal shell of revolution) which are homogeneous, isotropic, closed at the apex, and of uniform thickness. The investigation is carried out within the framework of the usual shallow shell theory for small displacements and negligible transverse-shear deformations. Exact interior solutions are obtained for shells acted upon by edge loads and edge moments. The constants of integration associated with these

interior solutions are expanded asymptotically in inverse powers of a large parameter. Retaining only the leading term of these expansions leads (in most cases) to known approximate results. Explicit expressions for the second-order terms are obtained. The interior stress state of shells subjected to polar harmonic axial surface loads is also investigated. Author

N65-15351*# National Aeronautics and Space Administration, Washington, D.C.
NATURAL VIBRATIONS OF THE CONICAL SHELL
K. Federhofer Nov. 1962 29 p refs
(NASA-TT-F-8261) OTS: HC $2.00/MF $0.50

Basic equations are derived for the flexural and extensional vibrations of a conical shell. Approximation solutions for these equations are presented. I.V.L.

N65-15375*# Lehigh U., Bethlehem, Pa. Inst. of Research
ON THE PREDICTION OF SOME RANDOM LOADING CHARACTERISTICS RELEVANT TO FATIGUE
James R. Rice, Ferdinand P. Beer, and Paul C. Paris Apr. 1964 42 p refs Presented at the 2d Intern. Conf. on Acoust. Fatigue, Dayton, Ohio, 29 Apr.–1 May 1964
(Grant NsG-410)
(NASA-CR-56152) OTS: HC $2.00/MF $0.50

This paper deals with the theoretical prediction of some statistical characteristics of continuous stationary random loadings which are relevant to studies of fatigue. Primary emphasis is given to the determination of the distribution and average height of load rises and falls. A summary is also given of some other statistical information useful in fatigue analysis. Particular examples are worked out for gaussian processes with idealized spectra, and experimental data on fatigue crack propagation under random loadings are cited. Author

N65-15400*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A BLAST-WAVE THEORY OF CRATER FORMATION IN SEMI-INFINITE TARGETS
William J. Rae and Henry P. Kirchner Apr. 1963 65 p refs Presented at the 6th Hypervelocity Impact Symp., Cleveland, 30 Apr.–2 May 1963
(Contract NAS3-2121)
(NASA-CR-60342) OTS: HC $3.00/MF $0.75

The approximations are chiefly concerned with the self-similar or progressing-wave nature of the solution, with the type of state equation used, and with the extent which the conservation of energy and momentum can be fulfilled. Neglect of momentum conservation is a good approximation, but use of the Mie-Grüneisen equation of state is largely incompatible with the assumption of similarity. An approximate nonsimilar solution for impact-generated shock propagation is derived, and shows agreement with observed shock-wave trajectories. To derive a penetration law from any solution, some point in the trajectory must be chosen as the crater radius, and it is argued that the target strength should play a role in its determination. Crater-formation criterion, related to the intrinsic shear strength of the target, is utilized with the nonsimilar solution, to derive a penetration law which correlates a large amount of data. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-14489# Maremont Corp., Pasadena, Calif. Research and Development Labs.
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Quarterly Report, 1 Jun.–31 Oct. 1964
M. A. Greenbaum, R. E. Yates, J. A. Blauer, M. A. Frisch, M. Arshadi et al [1964] 25 p refs
(Contract AF 04(611)-7414)
(QR-13; AD-609303)

Determination of the vapor pressure curve for BeF_2(s) between 713° and 793° K by means of the torsion effusion technique has led to values of 58.1 ±0.7 kcal/mole and 47.8 ±0.9 cal/degree mole for the enthalpy and entropy of sublimation of this material at 298° K. Combination of these values with previously reported values for the enthalpy and entropy of vaporization of BeF_2 leads to values of 1.6 ± 0.8 kcal/mole and 4.2 ±1.1 cal/degree/mole for the enthalpy and entropy of fusion of BeF_2 at its melting point (815° K). Employing a new experimental technique and a new method of data analysis, the dissociation energy of the F_2(g) molecule at 298° K has been found to be 41.1 kcal/mole. This value essentially substantiates a number of previously reported values in the 37 to 40 kcal/mole region. Author

N65-14533*# Multi-Tech., Inc., San Fernando, Calif.
LIQUID ROCKET COMBUSTION PROCESSES. TASK NO. 1: INITIATION OF LITERATURE SURVEY Progress Report
Frank B. Cramer [1964] 16 p refs Prepared for JPL *Its* Rept.-4244-1
(Contracts NAS7-100; JPL-950926)
(NASA-CR-60041) OTS: HC $1.00/MF $0.50

The mechanics of a comprehensive literature search in those fields pertinent to liquid rocket engine combustion was initiated. The problems of information retrieval are being studied for the early incorporation of an efficient retrieval system into this effort. Author

N65-14560*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL LOCAL HEAT-TRANSFER DATA FOR PRECOOLED HYDROGEN AND HELIUM AT SURFACE TEMPERATURES UP TO 5300° R
Maynard F. Taylor Washington, NASA, Jan. 1965 22 p refs
(NASA-TN-D-2595) OTS: HC $1.00/MF $0.50

Local values of heat-transfer coefficients and average friction coefficients were measured experimentally for precooled hydrogen and helium gases flowing through an electrically heated tungsten tube with a length–diameter ratio of 77 for the following range of conditions: local surface temperatures up to 5300° R, inlet gas temperatures from 252° to 325° R, inlet pressures from 37 to 93 pounds per square inch absolute, local bulk Reynolds numbers from 5700 to 48 400, local ratios of surface to bulk gas temperature up to 8, and local heat fluxes up to 2.37 million Btu per hour per square foot. A comparison of several methods of correlating local heat-transfer coefficients was made

for several types of wall temperature distributions, and one method was found to work exceedingly well in correlating hydrogen and helium data with surface-to-bulk gas temperature ratios up to 8. Average friction coefficients for both helium and hydrogen are compared with the Kármán–Nikuradse relation. Author

N65-14563*# National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTION TO THE AEROTHERMIC STUDY OF A FLAT JET EVOLVING IN THE PRESENCE OF A WALL [CONTRIBUTION A L'ETUDE AEROTHERMIQUE D'UN JET PLAN EVOLUANT EN PRESENCE D'UNE PAROI]
Jean Mathieu (Ph.D. Thesis—Grenoble U., 1959) Nov. 1964 61 p refs Transl. into ENGLISH
(NASA-TT-F-9088) OTS: HC $5.00/MF $1.00

Determination of the aerothermic characteristics of a hot jet striking a plate at various angles is discussed. The double problem of thermal exchanges and of the aerodynamics of a jet evolving in the presence of a wall is considered in particular. The discussion includes: (1) analytical considerations—dynamic equations of jet evolution, flow zone near the wall, equation of energy, thermal boundary in the neighborhood of the wall, thermal transfers and turbulent movement of fluids, and characteristic magnitudes of turbulence; (2) equipment—general characteristics and descriptions; and (3) measuring instruments and methods—velocity, temperature, heat flux, and turbulence measurements. P.V.E.

N65-14592# Pratt and Whitney Aircraft, Middletown, Conn.
FORCED CONVECTION BOILING POTASSIUM EXPERIMENTS
G. W. Bersin, J. Horan, and D. Costales 23 Dec. 1964 183 p
(Contract AT(30-1)-2789)
(PWAC-430) OTS: $5.00

Overall boiling heat-transfer coefficients up to 3000 Btu/hr-ft^2-°F were determined for a full length helical-insert-type potassium boiler tube at 100% exit quality. Boiling pressure drop data were obtained for both twisted-ribbon and helical-insert-type potassium boiler tubes over a range of exit qualities up to 100%. Liquid–liquid heat transfer data were obtained for a helical-insert-type boiler tube at Peclet numbers between 3 and 30 with corresponding Nusselt numbers between 0.01 and 0.02. System stability observations were made and are discussed with emphasis on boiler and condenser contributions. Author

N65-14626*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF SEVERAL ABLATION MATERIALS EXPOSED TO LOW CONVECTIVE HEATING RATES IN AN ARC-JET STREAM
Marvin B. Dow and William D. Brewer Washington, NASA, Jan. 1965 49 p refs
(NASA-TN-D-2577) OTS: HC $2.00/MF $0.50

An investigation was made of the performance of 11 different types of ablation materials bonded to beryllium or aluminum backup plates. Thirty-four specimens fabricated as flat square sections with a nominal side dimension of 5 inches (12.70 cm) were exposed to convective heating rates of less than 10 Btu/(sq ft)(sec) (0.114 MW/m^2) for exposure times in excess of 200 seconds in the 2500-kilowatt arc jet. Some of the specimens were tested in air; others, in a mixture of air and nitrogen. The back-surface temperature response, the mass-distribution loss of ablation materials, and the depth of thermal degradation are presented. The performance of each material during testing is also discussed. A comparison of measured and calculated back-surface temperature responses is presented for some of the ablation materials tested in the arc jet. Calculations were made for those materials for which data concerning physical and thermal properties were available. Reasonable agreement was obtained between experimental and calculated temperature responses. Author

N65-14674* Israel Program for Scientific Translations, Ltd., Jerusalem.
THERMODYNAMICS, A GENERALIZED APPROACH
A. I. Veinik 1964 269 p refs Transl. into ENGLISH of the book "Termodinamika" Minsk, Izd. Min. Vysshego, Srednego, Spets. i Prof. Obrazov. Belorussk. SSR, 1961 Published for NASA and NSF
(NASA-TT-F-148) OTS: $2.75

This text discusses, on an elementary level, the basic ideas of thermodynamics and attempts to combine systematically classical thermodynamics, the thermodynamics of irreversible processes, the theory of heat conduction, heat and mass exchange, etc. Such an overall picture of thermodynamics represents one comprehensive theory of transfer processes. Described are some new transfer laws and effects which become apparent in the course of a general macroscopic study of various types of phenomena, including thermal, mechanical, chemical, filtration, electrical, and magnetic phenomena. Author

N65-14711# Witwatersrand U., Johannesburg (Union of South Africa).
USE OF A MODIFIED LIEBMANN ANALOGUE FOR THE SOLUTION OF HEAT FLOW PROBLEMS IN DEEP MINES INCLUDING METHODS OF ESTIMATING DISCRETIZATION ERRORS
A. J. Dickson, A. M. Patterson, and C. J. Rallis Nov. 1964 5 p refs
(Rept.-21)

A brief description of a modified Liebmann analog, as well as its method of use in treating mining problems, is presented. This type of unit provides a solution to a fully discretized form of the diffusion equation. Some method of estimating the magnitude of the resulting differencing errors is therefore necessary. Two such methods are discussed. Author

N65-14723# Philco Corp., Philadelphia, Pa. Research Labs.
OPTICAL AND INFRARED PROPERTIES OF Al_2O_3 AT ELEVATED TEMPERATURES, VOLUME II Final Technical Report, 1 Aug. 1963–31 May 1964
D.A. Gryvnak and D.E. Burch [1964] 35 p refs
(Contract Nonr-3606(00); ARPA Order 237)
(U-2623; AD-606793) OTS: $2.00

Samples of single crystals of Al_2O_3 (sapphire) were heated in a furnace to various temperatures up to 1700° C. The absorption coefficient and index of refraction were measured as a function of wavelength from 0.546μ to approximately 6μ. The index of refraction was found to increase only slightly with temperature, but quite marked increases in the absorption coefficient were observed as the temperature was increased. The absorption coefficient was found to have a minimum in the neighborhood between 2μ and 3μ and to increase to a value a couple of orders of magnitude higher at approximately 6μ. Flames formed by burning H_2 and O_2 were used to heat the samples to even higher temperatures. At about 2020° C the absorption coefficient was found to be greater than the lower temperatures, except possibly in the region below about 1.5μ. As the temperature was increased further, a sudden increase in the emissivity was observed as the material became molten. The results indicate a

discontinuous increase in absorption coefficient as one passes from the solid to the liquid state that is probably equal to a factor of about 30 or 40, and is possibly even greater throughout the wavelength region from the visible to about 4μ. Author

N65-14767 Joint Publications Research Service, Washington, D.C.

OPTIMAL CONTROL IN HEATING OF MASSIVE BODIES

Yu. N. Andreyev and A. G. Butkovskiy *In its* Tech. Cybernetics, No. 5, 1964 4 Jan. 1965 p 62–75 refs (See N65-14762 05-10) OTS: $6.00

The problem of optimal control in heating of a massive body in furnaces of the chamber type is formulated (includes heating wells in which ingots are heated before rolling in a blooming mill). The solution of two problems of optimal control in heating of a uniform plate on the surfaces of which thermal exchange is taking place according to Newton's law, is presented. Author

N65-14807*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE IGNITION OF POWDERED METALS IN NITROGEN AND IN CARBON DIOXIDE

R. A. Rhein 30 Sep. 1964 29 p refs

(Contract NAS7-100)

(NASA-CR-60125; JPL-TR-32-679) OTS: HC $1.00/MF $0.50

The atmospheres of Mars and Venus are considered to consist essentially of mixtures of carbon dioxide and nitrogen. Experimental studies have shown that a number of powdered metals will ignite in carbon dioxide as well as in nitrogen. Metals shown to ignite in nitrogen are powdered lithium, beryllium, calcium, cerium, mischmetall, titanium, zirconium, thorium, and uranium. These metals will also ignite in carbon dioxide, in addition to the following, which ignite in carbon dioxide only: magnesium, aluminum, chromium, and manganese. The ignition temperatures for these metals are determined in order to develop appropriate fuels for use in the planetary atmospheres. Author

N65-14865# Stanford Research Inst., Menlo Park, Calif.

INVESTIGATION OF EQUATION OF STATE OF POROUS MATERIAL

G. R. Fowles Kirtland AFB, N. Mex., AF Weapons Lab., Aug. 1964 125 p refs

(Contract AF 29(601)-6024)

(WL-TDR-64-59; AD-607623) OTS: $5.00

Hugoniot data in the pressure range 40 to 500 kbar for porous playa are obtained by impedance-match methods using both in-contact and flyer-plate explosive arrangements. Two initial densities, 1.55 and 1.95 g/cm^3 (crystal density, 2.66 g/cm^3), of dry, reconstituted material are examined. The data show regions in which the pressure is multivalued. This behavior is attributed to polymorphic phase transitions in one or more of the constituent minerals. A simple, closed form expression for the zero-degree isotherm is presented which converges asymptotically to the behavior of a free-electron gas at extreme pressure. It also contains the principal term representing the pressure–volume behavior predicted by the Thomas–Fermi model. In addition an extensive review of the thermodynamics of equations of state is presented. Results of shock calculations in spherical geometry assuming hydrodynamic behavior of the medium are also presented. Author

N65-14876# Joint Publications Research Service, Washington, D.C.

INZHENERNO-FIZICHESKIY ZHURNAL (JOURNAL OF ENGINEERING PHYSICS), VOLUME VI, NO. 11, NOVEMBER 1963

31 Jan. 1964 223 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Minsk), v. VI, no. 11, Nov. 1963 p 3–137

(JPRS-23013; TT-64-21447) OTS: $3.50

CONTENTS:

1. EXPERIMENTAL DETERMINATION OF LOCAL VALUES OF HEAT-TRANSFER COEFFICIENTS IN TURBINES I. V. Il'Yinskiy and I. D. Garkusha p 1–10 refs (See N65-14877 05-33)

2. RESISTANCE AND HEAT EXCHANGE IN A POROUS SURFACE DURING A GRADIENT GAS FLOW P. N. Romanenko and V. N. Kharchenko p 11–22 refs (See N65-14878 05-33)

3. ON THE INFLUENCE OF RAREFACTION OF SUPERSONIC FLOW ON THE BASE PRESSURE OF A ROTATING BODY p 23–34 refs (See N65-14879 05-12)

4. MECHANISM OF HEAT EXCHANGE BETWEEN A FLUIDIZED BED AND SURFACE A. P. Baskakov p 35–48 refs (See N65-14880 05-33)

5. INVESTIGATION OF THE THERMAL DIFFUSIVITY (INTERMIXTURE OF PARTICLES) OF A PSEUDO-FLUIDIZED BED, BAFFLED BY SCREENS A. I. Tamarin and V. A. Borodulya p 49–60 refs (See N65-14881 05-33)

6. THERMODYNAMIC OPTIMIZATION OF TECHNOLOGICAL HEAT EXCHANGE SYSTEMS WITH CASCADE FLUIDIZED BEDS I. T. El'Perin and V. A. Minkov p 61–76 refs (See N65-14882 05-33)

7. CALCULATION OF A MULTIZONE BED THERMAL EXCHANGER WITH A MOVING BED A. I. Lyuboshits p 77–89 ref (See N65-14883 05-33)

8. TEMPERATURE CHARACTERISTICS OF ARC JETS Ye. V. Garkavyy and O. I. Yas'ko p 90–93 refs (See N65-14884 05-33)

9. THE DETERMINATION OF THE TRANSFER POTENTIAL OF OSMOTIC MOISTURE L. M. Nikitina p 94–99 refs (See N65-14885 05-33)

10. SPECIFIC HEAT OF EVAPORATION OF MOISTURE FROM THE CAPILLARIES OF A DISPERSE BODY V. M. Kazanskiy p 100–114 refs (See N65-14886 05-33)

11. A PROOF OF SOME RELATIONSHIPS WHICH CONNECT THE HEAT CONDUCTIVITY WITH OTHER CHARACTERISTICS OF A LIQUID S. S. Altynbayeva p 115–121 refs (See N65-14887 05-33)

12. THE FREE FLOW OF THIN FILMS OF A VISCOUS LIQUID ON A VERTICAL SURFACE B. S. Kasimov and F. F. Zigmund p 122–129 refs (See N65-14888 05-12)

13. DISTORTIONS OF A TEMPERATURE FIELD IN A SOLID HAVING SOME INSULATED RECTANGLUAR REGIONS A. A. Sholokhov p 130–140 refs (See N65-14889 05-33)

14. THE CALCULATION OF THE DOSE-STREAM DISTRIBUTION OF CAPTURE GAMMA-RAYS L. P. Bokacheva, K. K. Polkov, and L. N. Tabolina p 141–147 refs (See N65-14890 05-24)

15. THE KINETICS OF A REACTOR GOING OUT OF THE SUBCRITICAL STATE S. Dideykin p 148–156 refs

16. THE HEAT EXCHANGE OF A SURFACE WHICH IS IMMERSED IN A DEVELOPED HETEROGENEOUS FLUIDIZED LAYER N. V. Antonishin and S. S. Zabrodskiy p 157–172 refs (See N65-14891 05-33)

17. CALCULATION OF CURRENT-VOLTAGE CHARACTERISTICS OF CERTAIN TYPES OF THERMISTORS UNDER CONDITIONS OF NATURAL CONVECTION I. N. Rutskiy p 173–184 refs (See N65-14892 05-33)

18. INVESTIGATION OF THE MOTION OF SOLID PARTICLES IN INTERBLADE CHANNELS OF A TURBOCYCLONE ASH REMOVER A. M. Rozhdestvenskiy p 185–196 refs

19. A STUDY OF CONTACT HEAT EXCHANGE ON THE SURFACE OF A THREE-LAYERED SLAB OF FLOORING A. L. Usov p 197–201 refs

20. MASS-TRANSFER PROCESSES AND CRITICAL POINT PHENOMENA N. Ye. Khazanova and L. A. Rott p 202–218 refs (See N65-14893 05-33)

N65-14877 Joint Publications Research Service, Washington, D.C.

EXPERIMENTAL DETERMINATION OF LOCAL VALUES OF HEAT-TRANSFER COEFFICIENTS IN TURBINES

I. V. Il'yinskiy and I. D. Garkusha *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.) Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 1–10 refs (See N65-14876 05-33) OTS: $3.50

This article describes methods for determining localized coefficients for heat transfer from a gas or air environment to the walls of gas turbines and compressors. The results of an experimental determination of these coefficients are given and some general conclusions are drawn. Author

N65-14878 Joint Publications Research Service, Washington, D.C.

RESISTANCE AND HEAT EXCHANGE IN A POROUS SURFACE DURING A GRADIENT GAS FLOW

P. N. Romanenko and V. N. Kharchenko *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 11–22 refs (See N65-14876 05-33) OTS: $3.50

Results are given of an experimental investigation of the influence on heat exchange and resistance of the insufflation of different gases through a porous wall into a turbulent boundary layer, in the presence of a gradient hot-air flow. Author

N65-14880 Joint Publications Research Service, Washington, D.C.

MECHANISM OF HEAT EXCHANGE BETWEEN A FLUIDIZED BED AND SURFACE

A. P. Baskakov *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 35–48 refs (See N65-14876 05-33) OTS: $3.50

A theoretical formula was developed that relates the coefficient of heat exchange with density pulsations in a fluidized bed. The results obtained coincide with values obtained experimentally. Author

N65-14881 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF THE THERMAL DIFFUSIVITY (INTERMIXTURE OF PARTICLES) OF A PSEUDOFLUIDIZED BED, BAFFLED BY SCREENS

A. I. Tamarin and V. A. Borodulya *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 49–60 refs (See N65-14876 05-33) OTS: $3.50

Using the method of instantaneous heat source the coefficient of thermal diffusivity of a baffled layer of sand, the particles of which had an average size ranging from 0.2 to 1.41 mm., and which was pseudofluidized by air was determined. Author

N65-14882 Joint Publications Research Service, Washington, D.C.

THERMODYNAMIC OPTIMIZATION OF TECHNOLOGICAL HEAT EXCHANGE SYSTEMS WITH CASCADE FLUIDIZED BEDS

I. T. El'perin and V. A. Minkov *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 61–76 refs (See N65-14876 05-33) OTS: $3.50

Methods are considered for the thermodynamic optimization of cascade devices with fluidized beds. Optimization is achieved with respect to a sum of hydrodynamic and thermal losses in the device taking account of actual consumption. Author

N65-14883 Joint Publications Research Service, Washington, D.C.

CALCULATION OF A MULTIZONE BED THERMAL EXCHANGER WITH A MOVING BED

A. I. Lyuboshits *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 77–89 refs (See N65-14876 05-33) OTS: $3.50

In calculating the heat and mass exchange in a multizone bed heat exchanger with a moving bed, the following conditions are introduced: (1) The effect of internal thermal resistance is neglected. (2) The gas and the material temperature are constant in time. (3) Heat loss through the shaft walls is negligible. (4) The distribution of the gases in the bed and motion of the beds are uniform. (5) The bed consists of spherical particles of uniform dimensions. (6) The coefficient of heat exchange is related to the total geometrical surface of all the particles which make up the bed. (7) All zones are assumed equal in dimension and amount. P.V.E.

N65-14884 Joint Publications Research Service, Washington, D.C.

TEMPERATURE CHARACTERISTICS OF ARC JETS

Ye. V. Garkavyy and O. I. Yas'ko *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 90–93 refs (See N65-14876 05-33) OTS: $3.50

It is shown that there is a possibility of determining the temperature characteristics of the jets of an electric arc heater with eddy stabilization, in the form of a function of discharge parameters. Data are presented on the dependence of the form of the temperature profile of the jet and the relation of axis temperature to the average mass temperature and to the dimensions of the ends of the electrodes. Author

N65-14885 Joint Publications Research Service, Washington, D.C.

THE DETERMINATION OF THE TRANSFER POTENTIAL OF OSMOTIC MOISTURE

L. M. Nikitina *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 94–99 refs (See N65-14876 05-33) OTS: $3.50

The dependence of the transfer potential of osmotic moisture for definite chemical potential in the moist state of the material is obtained. Author

N65-14886 Joint Publications Research Service, Washington, D.C.

SPECIFIC HEAT OF EVAPORATION OF MOISTURE FROM THE CAPILLARIES OF A DISPERSE BODY

V. M. Kazanskiy *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 100–114 refs (See N65-14876 05-33) OTS: $3.50

It is shown that there can be a thermodynamically based dependence of specific heat of vaporization from a porous body on its porosity of structure and the moisture. It is established that the calculated data, obtained by use of assumed formulas, are in good agreement with the results of calorimetric determination of heat of vaporization of moisture from silica gels of various porous structures. It is shown that lowering of the surface tension of water significantly decreases the heat of vaporization of the capillary water and does not affect the heat of vaporization of the adsorbed moisture. Author

N65-14887 Joint Publications Research Service, Washington, D.C.

A PROOF OF SOME RELATIONSHIPS WHICH CONNECT THE HEAT CONDUCTIVITY WITH OTHER CHARACTERISTICS OF A LIQUID

S. S. Altynbayeva *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 115–121 refs (See N65-14876 05-33) O S: $3.50

The results of a study of the dependence of the heat conductivity of rosin and castor oil on temperature are analyzed. The empirical data obtained are compared with values of heat conductivity obtained from theory. Author

N65-14889# Joint Publications Research Service, Washington, D.C.

DISTORTIONS OF A TEMPERATURE FIELD IN A SOLID HAVING SOME INSULATED RECTANGULAR REGIONS

A. A. Sholokhov *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 130–140 refs (See N65-14876 05-33) OTS: $3.50

An analytical solution to the problem of heat conductivity, and results of particular geometries predicted from theory are presented. These are compared with experimental results. The solution is used to analyze and account for errors arising in measuring the temperature of a solid. Author

N65-14891 Joint Publications Research Service, Washington, D.C.

THE HEAT EXCHANGE OF A SURFACE WHICH IS IMMERSED IN A DEVELOPED HETEROGENEOUS FLUIDIZED LAYER

N. V. Antonishin and S. S. Zabrodskiy *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 157–172 refs (See N65-14876 05-33) OTS: $3.50

An attempt was made, on the basis of experimental research, to determine some of the unknown factors which affect the region of a fluidized layer. Some of the factors considered are: (1) the shape and size of the heat exchange surface; (2) the perturbing effect of the bodies immersed in the layer along the surface under study; (3) the frequency and amplitude of pulsations of the layer; and (4) the emergence of an electrostatic charge. The region of a developed fluidized layer indicates the conditions of fluidization close to maximum heat exchange and at large filtration velocities. Along with a discussion of the experimental results, an approximate analytical expression is developed for the coefficient of heat exchange of a heterogeneous layer with an infinite cylinder immersed in it. P.V.E.

N65-14892 Joint Publications Research Service, Washington, D.C.

CALCULATION OF CURRENT-VOLTAGE CHARACTERISTICS OF CERTAIN TYPES OF THERMISTORS UNDER CONDITIONS OF NATURAL CONVECTION

I. N. Rutskiy *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.) Vol. VI, No. II, Nov. 1963, 31 Jan. 1964 p 173–184 refs (See N65-14876 05-33) OTS: $3.50

Presented is a procedure for obtaining the equation for determining the heat transfer under conditions of free convection for thermistors of various shapes. The developed equation is then used to calculate (and recalculate) the current-voltage characteristics of the thermistors. The research was conducted on thermistors of type MMT-1, KMT-1, MMT-6, and KMT-11. All the thermistors have the shape of a bounded cylinder to which current-carrying conductors are connected. The dimensions of the thermistors studied were in these ranges: length, 3.4 to 12.5 mm, diameter, 0.6 to 2.0 mm. P.V.E.

N65-14893 Joint Publications Research Service, Washington, D.C.

MASS-TRANSFER PROCESSES AND CRITICAL POINT PHENOMENA A Review

N. Ye. Khazanova and L. A. Rott *In its* Inzh.-Fiz. Zh. (Journal of Eng. Phys.), Vol. VI, No. II, Nov. 1963 31 Jan. 1964 p 202–218 refs (See N65-14876 05-33) OTS: $3.50

One, two, and three-component systems are considered in discussing critical-phase equations of solutions. In addition, the kinetics of mass-transfer processes and fluctuation mechanisms are reviewed in detail. P.V.E.

N65-14917 Joint Publications Research Service, Washington, D.C.

CONDITIONS FOR TEMPERATURE REGULARIZATION OF MONOTONICALLY HEATED BODIES HAVING SIMPLEST SHAPES AND VARIABLE THERMOPHYSICAL PARAMETERS

Ye. S. Platunov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No 5, 1964 11 Jan. 1965 p 179–185 refs (See N65-14894 05-14) OTS: $6.00

An analysis is made of the temperature field of a plate, cylinder, and sphere heated monotonically with symmetrical boundary conditions. The temperature dependence of the thermophysical parameters of the materials of the bodies is taken into account. Quantitative relations are established for which the temperature field in the body or in its individual zones is governed by the conditions of the uniform regime of the second kind. Author

N65-14918 Joint Publications Research Service, Washington, D.C.

CONVECTIVE HEAT TRANSFER COEFFICIENT AT LOW PRESSURE

A. M. Kirik and I. I. Tuktayev *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 186–189 refs (See N65-14894 05-14) OTS: $6.00

Experimental results obtained in the determination of the coefficients of heat transfer from cylinders at air pressures ranging from 760 to 6×10^{-4} mm Hg are presented. It is shown that for bodies having an emissivity greater than 0.8, the pressure dependence obtained for a viscous regime can be extended without loss of accuracy to a viscous molecular regime. It was found that convection ceases to be effective at pressures greater than 1×10^{-3} mm Hg. P.V.E.

N65-14921 Joint Publications Research Service, Washington, D.C.

DETERMINATION OF WATER VAPOR CONTENT IN GASES WITH A CONDENSER

V. A. Potroshkov *In its* Izv. VUZov: Instr. Bldg., Vol. VII, No. 5, 1964 11 Jan. 1965 p 206–210 refs (See N65-14894 05-14) OTS: $6.00

Two identical vessels are used, one filled with moist gas and the other with dry air. The initial vapor content is found with the aid of a differential manometer. A mathematical formula is obtained to account for the temperature of the mixture before and after condensation. The effect of the manometer volume on measurement accuracy is examined, and an example is given characterizing the possible error if this volume is neglected. Author

N65-14944*# National Aeronautics and Space Administration, Washington, D.C.

EXPERIMENTAL INVESTIGATION OF THE COMBUSTION PROCESS OF NATURAL AND EMULSIFIED LIQUID FUELS [EKSPERIMENTAL'NOYE ISSLEDOVANIYE PROTSESSA GORENIYA CHASTITS NATURAL'NYKH I EMUL'GIROVANNYKH ZHIDIKH TOPLIV]

Y. M. Ivanov and P. I. Nefedov Jan. 1965 26 p refs Transl. into ENGLISH from Tr. Inst. Goryuch. Iskop., Akad. Nauk SSSR (Moscow), V. 19, 1962 p 35–45
(NASA-TT-F-258) OTS HC $1.00/MF $0.50

The injection of water into the cylinders of internal combustion engines has proved the value of using water that contains heavy-liquid fuels in the form of emulsions in industry, power engineering, and transportation. In addition to the study of the properties of water–fuel emulsion and of the process of its combustion in a flow, the mechanism of ignition and combustion of a single particle of emulsified fuel was investigated. Motion picture film of ignition and combustion provides a graphic representation of the process. Results of comparison of combustion of anhydrous and water-emulsified liquid fuels have proved the following: (1) Emulsified liquid fuels burn faster than anhydrous fuels. (2) Water in emulsified fuels does not impair but improves combustion. (3) The reduction of combustion time of emulsified fuels has a favorable effect on the burning of sooty residue. E.E.B.

N65-14950# Aerojet-General Corp., Sacramento, Calif.

INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Eighteenth Technical Operating Report, 1 Apr.–30 Jun. 1964

L. J. Rosen Aug. 1964 13 p refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept.-0372-01-18; AD-454417)

Apparent-flame strengths (AFS) for ammonia–oxygen–chlorine systems have been determined as a function of mass fraction of reactants in the initial reaction mixture. It has been demonstrated that NH_3-O_2-Cl_2 flames exist for large mass fractions of chlorine (up to 0.6) which is contrary to a previous hypothesis that NH_3-O_2-Cl_2 flames would not exist at chlorine mass fractions >0.45. It was found, however, that AFS measurements are not feasible at chlorine mass fractions > ~0.6 due to flame-out before axial extinguishment can occur. The AFS of these flames is inversely proportional to the mass fraction of chlorine and directly proportional to mass fractions of oxygen and ammonia. At mass fractions >0.4, <0.2, and <0.4 for Cl_2, O_2, and NH_3, respectively, the AFS varied only slightly with relatively large changes in concentrations of reactants. Author

N65-14973# Purdue U., Lafayette, Ind.

THERMODYNAMICS OF IRON-CARBON-SILICON AUSTENITE

Richard A. Peterson, Jr. (M.S. Thesis) Jan. 1964 82 p refs (AD-423006)

The carbon activity in the austenite phase region of the Fe-C-Si system was investigated at 1000°, 1100°, and 1200° C. An experimentally simple equilibration method was employed wherein small iron-base rods containing different silicon and/or carbon contents were sealed in a partially evacuated quartz capsule and held at the desired equilibration temperature for a time sufficient to establish carbon equilibrium. Eight carbon isoactivity curves were obtained in the austenite field. Of these eight curves, four were obtained at 1200° C, three were obtained at 1100° C, and one was obtained at 1000° C. Author

N65-14983# Bureau of Mines, Amarillo, Tex. Helium Research Center

A SURVEY OF EXPERIMENTAL METHODS FOR DETERMINING ENTHALPIES OF FLUIDS

Robert E. Barieau 1965 25 p refs
(BM-IC-8245)

In the design of plants to separate helium from natural gas, it is necessary to estimate the enthalpies of the various streams at various positions in the process. This Bureau of Mines report surveys the various methods that have been used to determine enthalpies and gives information on the organizations with such capabilities. The minimum information required for developing an enthalpy diagram is presented, and the relative merits of the various methods are discussed. It is concluded that methods that require no mass flow rate or energy measurements are to be preferred. Author

N65-14996# ARO, Inc., Arnold Air Force Station, Tenn.

ALTITUDE-VELOCITY TABLE AND CHARTS FOR IMPERFECT AIR

Clark H. Lewis and E. G. Burgess, III Arnold Eng. Develop. Center, Jan. 1965 145 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-214; AD-454078)

Normal shock wave parameters are presented in tabular and graphical form over the ranges of altitude = 10^4 (10^4) 4×10^5 ft and velocity = 6000 (10^3) 50 000 fps. The calculations are based on the thermodynamic data of Hilsenrath and Klein, of Lewis and Neel, and of the 1962 U.S. Standard Atmosphere. The results are tabulated in the form of ratios of enthalpy, pressure, density, and temperature with the free-stream quantity. In addition, speed of sound, compressibility factor, sphere stagnation heat-transfer rate, and free-stream unit Reynolds number are also given. Altitude–velocity charts are given for the principal quantities of interest. Correlations of sphere stagnation heat-transfer rates based on Fay and Riddell and Fay and Kemp are presented. The constant K in $(1/2)\ \rho_1 U_1^2 = K p'_0$ was determined to be 0.52 ± 0.01 for $U_1 \geq 10\,000$ fps. Author

N65-15069# Suffield Experimental Station, Ralston, Alberta (Canada).

TOTAL RADIANT ENERGY EMITTED FROM A 20 TON AND A 5 TON SURFACE BURST OF TNT: 1963 EXPERIMENTS

F. L. Mc Callum and W. E. Slack 16 Nov. 1964 10 p refs (SUFFIELD-TN-134)

This note describes measurements obtained of the total radiant energy emitted from 20-ton and from 5-ton surface

burst charges of TNT, as recorded by thermoelectric disc calorimeters. To a first approximation these measurements indicate that 7.0% and 6.4%, respectively, of the total energy was in the form of thermal radiation. Author

N65-15070# Suffield Experimental Station, Ralston, Alberta (Canada).
THE MEASUREMENT OF AIR BLAST PRESSURE IN TNT EXPLOSIONS WITH SPECIAL REFERENCE TO AN EXPLOSION OF 100 TONS TNT AT GROUND LEVEL
T. K. Groves 2 Nov. 1964 48 p refs
(Suffield-TP-255)

Problems involved in attempting to measure the hydrostatic pressure in a blast wave are discussed. The problems are illustrated by reference to an explosion of a nearly hemispherical stack of 100 tons of TNT. Problems discussed include the fitting of empirical equations to shock front radius-time data, fitting of hydrostatic pressure-time data, wind correction to photogrammetric data, invisible shock fronts, and detection of very weak shocks by photography of the patterned backdrop. Experimental results are presented for the 100 ton TNT charge exploded at ground level. P.V.E.

N65-15077# California U., La Jolla.
THERMAL PROPERTIES OF THE INHOMOGENEOUS ELECTRON GAS
N. David Mermin Sep. 1964 15 p ref
(Contract Nonr-2216(11))
(TR-26; AD-607713)

A variational property of the ground state energy of an electron gas in an external potential $v(\underline{r})$, derived by Hohenberg and Kohn, is extended to nonzero temperatures. It is first shown that in the grand canonical ensemble at a given temperature and chemical potential, no two $v(\underline{r})$ lead to the same equilibrium density. This fact enables one to define a functional of the density, $F[n(\underline{r})]$, independent of $v(\underline{r})$, such that the quantity $\Omega = \int v(\underline{r})\, n(\underline{r})\, d\underline{r} + F[n(\underline{r})]$ is minimum and equal to the grand potential, when $n(\underline{r})$ is the equilibrium density in the grand ensemble in the presence of $v(\underline{r})$. Author

N65-15078# North Carolina State Coll., Raleigh.
A STUDY OF CONVECTION BOILING INSIDE CHANNELS Progress Report, 1 Jul.–30 Sep. 1964
J. K. Ferrell 30 Sep. 1964 36 p
(Contract AT(40-1)-2950)

A stainless steel tube honed to 0.466-inch i.d. was used to determine the effects of several variables upon two-phase single component frictional and contraction–expansion pressure losses for both horizontal and vertical and heated and unheated channel surfaces. The count rate data from 11 test points along the test section of the tube were reduced by equations to determine the steam volume fraction. Pressure versus fluid quality plots from a series of runs are presented. It was found that the pressure drop is a function of fluid enthalpy and independent of the inlet temperature. G.G.

N65-15115# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE SIMILARITY OF NON-STATIONARY HEAT TRANSFER OF SOLIDS UNDER IDENTICAL CONDITIONS
E. V. Kudryavtsev and N. V. Shumakov 28 Oct. 1964 12 p refs Transl. into ENGLISH from Tr. Mosk. Inst. Inzh. Zheleznodorozhnogo Transp. (USSR), v. 139, 1961 p 122–130
(RSIC-314; AD-609160)

Reported is an analysis of the investigative results of unsteady heat exchange in solid bodies under identical conditions of practical importance. An equation is presented which indicates the relation obtained as a result of experimental investigations of the heating (cooling) processes of solid bodies in identical conditions of nonstationary heat transfer. The results from this equation enable the simulation of processes of nonstationary heat transfer extensively, and also simplify calculations of nonstationary temperature fields in solid bodies. R.R.D.

N65-15116# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE ALGEBRA OF RESOLVING FLUXES IN RADIANT EXCHANGE
G. L. Polyak and V. N. Adrianov 1 Dec. 1964 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 5, no. 7, 1962 p 70–77
(RSIC-331; AD-609161)

An effective system of equations for calculating radiant exchange in an arbitrary system of bodies is proposed. By means of transition into resolvant (solving) fluxes, it is possible to separate temperature factors and optic geometric parameters of a radiating system. The processes of radiant exchange are described by Fredholms' integral equations of a second kind. Two possible approaches to solving the given problem are considered: (1) The initial integral equation of radiant exchange in which an inherent radiation occurs is directly approximated by a finite system of algebraic equations. (2) The solution of the basic integral equation is written by means of a resolving formula, and the resolving kernel (resolvant) is found by solving an auxillary integral equation. The second approach gives very general results since the temperature and optic geometric factors of the radiating system are distinct from each other. Both approaches should not be compared with each other; rather, a preference should be made of either approach. This article examines the second approach in zonal methods in radiant exchange. This method is further improved by using a simple system of equations for calculating resolving fluxes. R.W.H.

N65-15143*# Heat Technology Lab., Inc., Huntsville, Ala.
ANALYSIS OF THERMAL ENVIRONMENT PROBLEMS AND THE CREATION OF ANALYTICAL TOOLS FOR SELECTED SITUATIONS ON SATURN VEHICLES, PHASE II Final Report
15 Oct. 1964 129 p refs
(Contract NAS8-11558)
(NASA-CR-60200; HTL-TR-20; Phase II) OTS: HC $4.00/MF $1.00

A theoretical investigation was made of free-molecule flow through a duct of circular cross section. The molecular flux to the duct wall and exit plane was calculated along with the total flow rate through the duct. The density field was calculated at the duct exit and along the centerline for various duct-wall temperature and thermal accommodation coefficients. It was concluded that an experimental determination of the thermal accommodation coefficient can be made by measuring the effect of the duct-wall temperature on the density field. Author

N65-15151*# Oklahoma State U., Stillwater.
SPACECRAFT TEMPERATURE CONTROL BY THERMOSTATIC FINS-ANALYSIS, PART II

J. A. Wiebelt, J. F. Parmer, and G. J. Kneissl Washington, NASA, Jan. 1965 33 p refs
(Grant NsG-454)
(NASA-CR-155) OTS: HC $2.00/MF $0.50

Further analysis of a method of spacecraft temperature control is given. The basic configuration consists of fins which are bimetallic strips changing their radius of curvature as a function of spacecraft skin temperature, which is a function of solar azimuth and zenith angles. Analytical work includes the case of finite length surfaces with either emitting or non-emitting fins. In addition, an integrating sphere reflectometer was constructed so that the reflective properties of the thermostatic fins could be measured. A full size model of the spacecraft surface system was designed for testing in a space simulator. R.L.K.

N65-15157*# National Aeronautics and Space Administration, Washington, D.C.
TEMPERATURE DISTRIBUTION IN AN INFINITE CYLINDER AND IN A SPHERE IN NONMONOCHROMATIC RADIATIVE EQUILIBRIUM [O RASPREDELENII TEMPERATURY V BESKONECHNOM TSILINDRE I V SFERE PRI NEMONOKHROMATICHESKOM LUCHISTOM RAVNOVESII]
Ye. S. Kuznetsov Jan. 1965 37 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 2, no. 2, 1962 p 217–240
(NASA-TT-F-9232) OTS: HC $2.00/MF $0.50

The nonmonochromatic radiative equilibrium of an infinite cylinder is analyzed mathematically in detail, with an outline of the extension to the spherically symmetrical case indicated in general terms. An integral equation is derived for the temperature distribution and is interpreted on the assumption that the external radiation is isotropic, the absorption depending on the frequency but not on the coordinates. The kernel of the equation is isolated in explicit form. The existence and uniqueness of the solution are rigorously demonstrated. The solution for surface reflection in the absence of external radiation is discussed in detail for the special case of frequency-independent absorption (gray-body problem) and is then generalized to the frequency-dependent absorption problem. Author

N65-15194# Polytechnic Inst. of Brooklyn, N.Y.
REVIEW OF THEORETICAL INVESTIGATIONS ON THE EFFECT OF HEAT TRANSFER ON LAMINAR SEPARATION
Morris Morduchow Jul. 1964 44 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-831; AFOSR-64-1658; AD-609575)

A review is made of theoretical investigations on the effect of heat transfer on laminar separation in classical steady two-dimensional high-speed or low-speed boundary-layer flow. Particular emphasis is placed on the effect of wall temperature on the location of the separation point. A review of results on the effect of Mach Number on the laminar separation point for a linearly diminishing external velocity and zero heat transfer is given. Author

N65-15199# Purdue U., Lafayette, Ind. Jet Propulsion Center
AN INVESTIGATION OF COMBUSTION PRESSURE OSCILLATIONS IN ROCKET MOTORS BURNING UNMIXED GASEOUS PROPELLANTS
M. J. Zucrow, J. R. Osborn, and J. M. Bonnell Aug. 1964 235 p refs
(Grant AF-AFOSR-62-360)
(TM-64-6; AD-451258)

An investigation was conducted to determine the underlying factors that influence the occurrence and propagation of combustion pressure oscillations in rocket motors burning unmixed gaseous propellants. The effects of injection parameters, combustion chamber geometry, and the chemical differences in the propellants were studied at different mean combustion pressures. The results of the experiments indicated that the incidence of combustion pressure oscillations depended primarily on the mode of injection, and that the other injection variables affected the amplitudes of the oscillations. Experimental results obtained with the 7-in. diameter, 6-in. long motor burning ethylene–air propellants were correlated by the following similarity parameters: (1) energy loss parameter; (2) heat release rate parameter; (3) motor Reynolds number; (4) injection Reynolds number; and (5) three mixing parameters. The correlations related the incidence of combustion pressure oscillations to the steady-state operating conditions of the motor, the energy lost through the chamber wall, the mixing of the propellants, and possibly the heat release rate. R.R.D.

N65-15227*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL OBSERVATIONS OF TRANSIENT BOILING OF SUBCOOLED WATER AND ALCOHOL ON A HORIZONTAL SURFACE
Robert W. Graham Washington, NASA, Jan. 1965 27 p refs Film supplement to this report is available on loan from Lewis Research Center
(NASA-TN-D-2507) OTS: HC $1.00/MF $0.50

Fast-response thermometry and high-speed motion pictures were employed in a study of the transient-heating mechanisms that take place as nucleate boiling develops on a horizontal surface. Evidence of free convection as well as thermal diffusion was observed. For subcooled conditions, an overshoot and a significant undershoot in surface temperature occur near the end of the transient. The latter coincided with the development of a large vapor mass on the surface. Transient thermal-layer growth histories, measured with shadowgraphs, are reported for water, and the dependence of thermal-layer thickness on bulk temperature is shown. The transient-boiling data are discussed in terms of their relation to the hysteresis phenomenon noted in steady-state nucleate boiling. Surface condition (number of nucleation sites) and gravity effects on the transient boiling process are discussed. Author

N65-15229*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
IMPROVED METHOD OF PREDICTING SURFACE TEMPERATURES IN HYDROGEN-COOLED NUCLEAR ROCKET REACTOR AT HIGH SURFACE- TO BULK-TEMPERATURE RATIOS
John V. Miller and Maynard F. Taylor Washington, NASA, Jan. 1965 24 p refs
(NASA-TN-D-2594) OTS: HC $1.00/MF $0.50

In extrapolating presently used gaseous-hydrogen heat-transfer correlations to conditions far removed from the experimental points, unexplained behavior in the predicted results of such equations was noted. Experimentally, under the proper circumstances, a small reduction in the bulk hydrogen temperature can cause an increase rather than a decrease in the surface temperature of a constant-heat-flux test specimen. Mathematically, the correlations used at the present time exhibit the same effect, but usually to a much greater degree, and result in some questionable values at

higher surface temperatures. To determine whether a more accurate method of predicting heat transfer at high surface-to bulk-temperature ratios is available, various correlations were examined. The result indicates that a correlation is available which achieves an appreciable decrease in the data scatter and at the same time reduces (but does not eliminate) the anomaly noted with equations now commonly used. The variables considered in this investigation were: (1) the ratio of distance from entrance L to hydraulic diameter D between 10 and 240, (2) the bulk fluid temperature from 200° to 2800° R, and (3) the ratio of wall temperature to bulk fluid temperature between 1.1 and 8.0. The application of this improved correlation to a particular problem encountered in nuclear rocket reactor design is also discussed. Author

N65-15268# Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
FIELD CALORIMETRY/CHEMICAL STUDIES Quarterly Technical Report, 15 Jun.–14 Sep. 1964
Earl C. Klaubert 27 Oct. 1964 37 p ref
(Contract DA-18-035-AMC-258(A); ARPA Order 535)
(QTR-1; AD-450369)

The purpose of this program is to develop a methodology by which to define quantitatively the heat flux from fires of flame fuels burning under field conditions. Work involved indoor fires, mostly of 11-inch diameter with a few of 22.5-inch diameter. Spectra were obtained for hexane, napalm test solvent, and benzene at constant horizontal viewing angle, and with the spectrometer tilted upward to include the thermal column above the flame. One fuel (comparing 11-inch with 22.5-inch fires) showed that the larger fire resembled continuum radiation. Temperatures at various heights on the centerline of the thermal column were obtained. Radiation intensity at a distance was measured as a function of angle of elevation from the base of the fire from −45° to +90°, for the three fuels. Radiant energy, with assumed spherical symmetry, was compared with the energy required to vaporize the three fuels at observed rates of consumption. Preparation of facilities for large-scale field tests is described. Author

N65-15296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COOLING OF ROCKET ENGINES
Dragoljub Jovasevic 14 Oct. 1964 21 p Transl. into ENGLISH from Vojnotehnicki Glasnik (Yugoslavia), no. 10, 1963 p 735–743
(FTD-TT-64-792/1+2; AD-450971)

Heat exchange is discussed in terms of airing, convection, and transfer. Methods for cooling solid-propellant rocket engines include protecting the rocket engine walls by selection of basic construction material to increase the thickness, selecting materials for high temperatures, finding new materials with high melting points, lining walls with heat-resistant and insulation materials. Both external and internal cooling are considered. The problem of convectional exchange of heat leads to the use of cooling jackets, which are described in regard to size, shape, and material for construction. Methods of fuel input are taken into consideration. R.E.S.

N65-15337*# National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
IBM 7090 FORTRAN II PROGRAM FOR THERMODYNAMIC PROPERTY COMPUTATIONS. ENTHALPY-PRESSURE OR PRESSURE-DENSITY AS INDEPENDENT COORDINATES
J. G. Hust 15 Oct. 1964 34 p refs
(NASA Order R-45)
(NASA-CR-60274; NBS-8474) OTS: HC $2.00/MF $0.50

Two FORTRAN II subroutines for the calculation of thermodynamic properties of oxygen using pressure and density or pressure and enthalpy as independent coordinates are described. The numerous function subprograms and subroutines required for execution of these computations are also described. Listings of all FORTRAN decks are included, along with brief descriptions of the basic mathematical methods employed. Author

N65-15341# Toronto U. (Canada). Inst. for Aerospace Studies
THERMODYNAMIC AND COMPOSITION DATA FOR CONSTANT-VOLUME COMBUSTION OF STOICHIOMETRIC MIXTURES OF HYDROGEN-OXYGEN DILUTED WITH HELIUM OR HYDROGEN
André Benoit Nov. 1964 180 p refs
(Contract AF 33(657)-7874)
(UTIAS-TN-85)

The equilibrium thermodynamic properties of the burned gases resulting from complete combustion at constant volume of a hydrogen–oxygen stoichiometric mixture diluted with an excess of hydrogen or helium have been computed for a wide range of initial pressures (from 1 to 10000 atmospheres), assuming no dissipative effects. The dissociations taken into account are $H_2 \rightleftharpoons 2H$, $O_2 \rightleftharpoons 2O$, $OH \rightleftharpoons O + H$, $H_2O \rightleftharpoons 2H + O$, and the initial gaseous mixture is taken at room temperature (298.16° K). For the initial mixtures represented by the formula $(2 + m)H_2 + O_2 + nHe$, a computer program written in FORTRAN II for a 7090 IBM computer was utilized, and was convenient for the computation of the postcombustion properties for any set of values of m and n within the ranges $0 \leq m \leq 6$ and $0 \leq n \leq 16$. Results are tabulated and represented graphically for two particular types of dilution. A detailed list of tables and figures are included to provide ready and rapid access to any set of results. Author

N65-15356# Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
THE COOLING OF A GAS MOVING IN A FLAT CHANNEL [OKHLAZHDENIE IZLUCHENIEM GAZA, TEKUSHCHEGO v PLOSKOM KANALE]
V. N. Vetlutskii and A. T. Onufriev May 1964 20 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1962 p 29–34
(Grant NsF G-23170)
(A&ES-TT-11)

An approximate method is described for the solution of the problem of cooling by radiation of a gray gas which flows in a flat channel. The equations of diffusion approximation are being applied here to describe radiative transfer. The equation system is solved by the method of integral relations of A. A. Dorodnitsyn. To obtain a qualitative concept of the problem and to verify the exactness of the numerical method, solutions of linear problems are obtained. As a model of the real gas flow, calculations of airflow at an initial temperature of 10000° K and at pressures of 10 and 100 atm are presented. The molecular or turbulent heat conduction is neglected because in some cases it may strongly change the picture of temperature distribution. Author

N65-15402*# Northrop Corp., Hawthorne, Calif. Northrop Space Labs.
THERMAL CONTROL BY USE OF FUSIBLE MATERIAL Fourth Monthly Progress Report, Jun. 1964

A. Shlosinger 8 Jul. 1964 26 p
(Contract NAS8-11163)
(NASA-CR-60350) OTS: HC $2.00/MF $0.50

Analytical studies of a radiative fin's temperature distribution were performed under consideration of the fin's thickness, steady-state temperature distribution, heat rejection, and other input parameters, and the values are presented in plots. The thermophysical properties of normal paraffin with an even number of carbon atoms from 41 to 30 and a melt temperature range of 40° to 150° F were considered for their use as thermal control fusible materials. Suitable n-paraffins are considered for camphene and/or formic acid substitution. A Reischauer pycnometer was calibrated and used to determine the weight of formic acid, camphene, and n-hexadecane. The temperature-density values were gained by calculations from the observed values and the temperature-specific volume curves are presented in graphs. A graduated glass cylinder was employed to determine the volume change and melting point of n-hexadecane at 61° F, of camphene at 115° F, and of formic acid at approximately 47° F. G.G.

N65-15425*# General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
TOTAL EMISSIVITY OF HOT WATER VAPOR. I: THE HIGH-PRESSURE UPPER LIMIT
C. C. Ferriso, C. B. Ludwig, and F. P. Boynton Sep. 1964 35 p refs
(Contract NAS8-11363)
(NASA-CR-60353; GDA-DBE64-055) OTS: HC $2.00/MF $0.50

The total emissivity of water vapor and the relative energy distributions in various broadband spectral regions were calculated from experimental thin-gas spectral data at temperatures between 500° and 2200° K and optical pathlengths between 0.1 and 10000 cm-atm. The calculation provides an upper limit to the emission which should be useful in heat transfer calculations and the design of thermal protection systems. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-14534*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
[MULTIDISCIPLINARY RESEARCH IN THE SPACE RELATED PHYSICAL, ENGINEERING, SOCIAL AND LIFE SCIENCES] Quarterly Progress Report No. 75
Y. W. Lee et al 15 Oct. 1964 56 p refs
(Grants NsG-496; NSF GP-2495; NIH G-MH-04737-04)
(NASA-CR-60042) OTS: HC $3.00/MF $0.50

Various research on space-related sciences is reported. Input to statistical communication theory discusses the characterization of a class of nonlinear systems, along with a transform analysis of nonlinear systems with sampled input and output. Ideas on such subjects as the syntax of the verb "wait", the phonology of Old Church Slavonic and Russian, and French syntactic construction, are found under linguistics. Research on cognitive information processing is reported in such areas as bilingual facilitation of short-term memory, picture processing, and sensory aids. Rhythmic afterdischarge to flashes is discussed under communications biophysics. Theories on reticular formation, observation and control, biological tests of La^{+++}, Cs^{+}, and Rb^{+}, extension of the membrane hypothesis, olfactory processes, entoptic phenomena, visual illusions, and a physiological amplifier circuit are among the subjects included in the section on neurophysiology. M.G.J.

N65-14635# Air Force Office of Scientific Research, Washington, D.C.
PROCEEDINGS OF THE 1st USAF SCIENTIFIC AND TECHNICAL INFORMATION CONFERENCE
A. G. Hoshovsky, ed. [1963] 175 p refs Conf. held at Dayton, Ohio, 30 Sep.–4 Oct. 1963
(OAR-15; AD-450000)

CONTENTS:

1. OBSERVATIONS OF THE NATIONAL SCIENTIFIC AND TECHNICAL INFORMATION PROBLEMS W. Knox p 9–13
2. THE DoD TECHNICAL INFORMATION PROGRAMS W. Carlson p 14
3. DEPENDENCE OF SUPERIOR WEAPONS ON SCIENTIFIC AND TECHNICAL INFORMATION M. Demler p 15–20
4. COUPLING OF RESEARCH AND EXPLORATORY DEVELOPMENT D. Ostrander p 21–25
5. RESEARCHERS' NEEDS AND OBLIGATIONS FOR STINFO M. Senko p 26–31
6. MANUFACTURERS' NEEDS AND OBLIGATIONS FOR STINFO Lee H. Foster p 32–37
7. MANAGEMENTS' NEEDS AND OBLIGATIONS FOR STINFO J. Kibbee p 38–43
8. DoD USER SURVEY J. Sayer p 44–50 refs
9. UTILIZATION OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION (STINFO) S. Passman p 51–56
10. CANADIAN APPROACH TO STINFO TRANSFER L. Mac Rae p 57–63
11. LOCAL ACCESS TO AEROSPACE INFORMATION M. Day p 64–72
12. PUBLICATIONS AS A MEDIUM FOR STINFO TRANSFER J. Gratton p 73–76
13. SIE PROGRESS IN PHYSICAL SCIENCES M. Freeman p 77–83
14. NON-DoD ACTIVITIES IN THE TRANSFER OF STINFO M. McFarland p 84–87
15. EXPERIENCE WITH INFORMATION CENTERS F. Koether p 88–94
16. REQUIREMENTS FOR DEVELOPING A MILITARY STINFO PROGRAM A. Aines p 95–99
17. THE TRANSFER OF SCIENTIFIC AND TECHNICAL INFORMATION BETWEEN ORIGINATOR AND USER M. Schrenk p 100–104
18. CURRENT CAPABILITIES OF DDC J. Vann p 105–108
19. ACQUISITION OF FOREIGN TECHNOLOGY AND HOW IT IS TRANSFERRED TO THE SCIENTIFIC AND ENGINEERING COMMUNITY P. Gwynn p 109–116
20. IDENTIFY COMMAND NEEDS FOR STINFO p 117–126
21. EXCHANGE OF STINFO BETWEEN ORIGINATOR AND USER p 127–132
22. FUNCTIONS AND TRAINING OF STINFO OFFICERS p 133–136
23. THE RESPECTIVE ROLES OF INFORMATION CENTERS, TECHNICAL LIBRARIES, DDC AND THEIR RELATION TO STINFO p 137–141

24. RELATION BETWEEN FOREIGN TECHNOLOGY AND STINFO p 142–147

25. STINFO MANAGEMENT AND COMMUNICATION p 148–150

N65-14746# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 134

8 Jan. 1965 64 p refs Transl. into ENGLISH of 9 articles from K'O hsueh T'ung pao (Peking), no. 10, Oct. 1964 p 854–861, 865–868, 928–941

(JPRS-28212; TT-65-30098) OTS: $3.00

CONTENTS:

1. RAPID EXPANSION OF CHINESE METEOROLOGICAL STUDIES Chen-ch'ao Ku p 1–5

2. CHAIRMAN MAO SPEAKS ON REVOLUTION Jen-chih Hou p 6–10

3. GREAT CHANGES IN CHINESE CHEMICAL SCIENCES Shih-hsien Yang p 11–13

4. SCIENTIFIC RESEARCH SERVICING SOCIALIST CONSTRUCTION Yao-tseng Huang p 14–16

5. SCIENCE AND TECHNOLOGY WORKERS FOLLOW SPECIALIZED PATH Shao-pao Liao p 17–20

6. FOLLOWING MAO TSE-TUNG AND BECOMING A REVOLUTIONARY SCIENTIFIC WORKER Shih-chun Ma p 21–24

7. REPORT ON THE HSI-HSIA-PANG-MA MOUNTAIN REGION Ya-feng Shih and Liu-Tung-sheng p 25–53

8. INORGANIC THIN-LAYER CHROMATOGRAPHY RESEARCH (II) SEPARATION OF GOLD AND ELEMENTS OF THE PLATINUM FAMILY Meng-yen Wu and Liang-feng Wu p 54–56 refs

9. DISCOVERY OF APE MAN TEETH AT LAN-T'IEN-HSIEN OF SHENSI PROVINCE Ju-k'ang Wu p 57–60 refs

N65-15062*# National Aeronautics and Space Administration. Washington, D.C.

ELEVENTH SEMIANNUAL REPORT TO CONGRESS, JANUARY 1–JUNE 30, 1964

James E. Webb 13 Nov. 1964 257 p

GPO: HC $1.00; OTS: MF $1.50

The following activities and accomplishments are discussed: *Manned Space Flight, Scientific Investigations in Space, Satellite Applications, Advanced Research and Technology, Nuclear Propulsion and Power Generation, Tracking and Data Acquisition, International Programs, Grants and Research Contracts Activities, Informational and Educational Programs,* and *Personnel Management, Procurement, and Support Functions.* G.G.

N65-15102# Stanford U., Calif. Inst. for Mathematical Studies in the Social Sciences

THE THEORY OF GROWTH—A WALRASIAN GROWTH MODEL

Michio Morishima 30 Nov. 1964 65 p refs

(Contract Nonr-225(50))

(TR-129; AD-609306)

Many self-contradictions inherent in the concepts which economists have used to develop mathematical models for growth equilibrium are reflected in the conclusions they have reached. The Walrusian short-run equilibrium theory assumes that the economy is classified into the consumption-goods industry and the capital-goods industry, with no possibility of joint production. In the long-run equilibrium model (in which the given rate of real wages is exogeneously fixed), the stock of capital, the labor force, and the outputs of two industries grow at a common rate and prices remain unchanged; the golden equilibrium. Even in a multisectoral model (in which i.e., production requirements, competitive pricing, depreciation, wages, and entrepreneurial activity are considered), the inference that the stability on the output side is incompatible with stability on the price side is based on restrictive assumptions. The conclusion is drawn that the dual stability–instability theorem is true only in the laboratory. M.G.J.

N65-15153*# National Aeronautics and Space Administration. Washington, D.C.

INDEX TO NASA TECH BRIEFS, ISSUE NO. 1

Jan. 1965 54 p refs

(NASA-SP-5021) OTS: HC $3.00/MF $0.50

This index has been prepared as a guide to technological innovations derived from the NASA space program. The publication is arranged in two major sections. The first contains a listing of the citations and abstracts of all NASA Tech Briefs published to date, arranged by subject category for ease of scanning. The second comprises three indexes: Subject Index, Originator/Tech Brief Number Index, and Tech Brief/Originator Number Index. Each Tech Brief citation is prefixed by a Tech Brief number. The separate indexes contain explanatory notes which guide the user to the desired Tech Brief. Author

N65-15176# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 133

8 Jan. 1965 28 p refs Transl. into ENGLISH

(JPRS-28198; TT-65-30094) OTS: $2.00

CONTENTS:

1. MATHEMATICAL THEORY OF ROCKET FLIGHT Chih-chiang Yeh p 1–15 refs (See N65-15177 05-31)

2. PRELIMINARY RESULTS IN STUDYING EXPLOSION FORMING TECHNIQUE p 16–18 (See N65-15178 05-15)

3. AN AUTOMATIC EQUALLY IONIZED ARC CUTTER p 19

4. TS'AI TSU CHUAN—A SPECIALIST ON ELECTRIC LIGHT SOURCES WHO EMERGED FROM THE WORKING CLASS p 20–21

5. WEATHERCASTING FROM THE WHITE CLOUD MOUNTAINS (PAI-YUN SHAN) p 22–25

N65-15188*# Washington U., St. Louis, Mo.

PRODUCT MANAGEMENT FOR DEFENSE/SPACE MARKETS

Murray L. Weidenbaum [1964] 10 p refs Presented to Am. Marketing Assn., Chicago, 29 Dec. 1964

(Grant NsG-342)

(NASA-CR-60227) OTS: HC $1.00/MF $0.50

The defense–space market is an area of industry where, although an identifiable activity labeled product management generally does not exist, the function of product management may be of unparalleled importance. This paper describes the unique characteristics of the military–space market and the unusual distribution of effort within the overall marketing

function. Because of the extremely rapid rates of product innovation and product obsolescence, the management decisions critical to the existence and growth of the military-oriented company relate to the composition of its future product line.
Author

34

N65-15412# Aeronautical Research Labs., Melbourne (Australia).

ANNUAL REPORT, 1963–64

[1964] 49 p refs

Research is reported in the areas of aerodynamics, structures, materials, mechanical engineering, guided weapons, flight and operational research, engineering facilities, instrumentation, and scientific photography.
R.L.K.

Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in twelve Federal Regional Technical Report Centers. Each Center, located in the organizations listed below, is prepared to furnish the general public services as personal reference, interlibrary loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

California: University of California, Berkeley
University of California, Los Angeles
Colorado: University of Colorado Libraries, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: MIT, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington Library, Seattle

In addition, NASA publications are currently being forwarded to the public libraries in the cities listed below:

Alabama: Birmingham
Alaska: Anchorage
Arizona: Phoenix
Arkansas: Little Rock
California: Los Angeles, Oakland, San Diego, San Francisco
Colorado: Denver
Connecticut: Hartford, Bridgeport
Delaware: Wilmington
Florida: Miami
Louisiana: New Orleans
Maryland: Enoch Pratt Free Library, Baltimore
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul
Missouri: Kansas City, St. Louis
New Jersey: Trenton
New York: New York State Library, Brooklyn, Buffalo, Rochester
North Carolina: Charlotte
Ohio: Cleveland, Cincinnati, Dayton, Toledo
Oklahoma: Oklahoma City
Pennsylvania: Pittsburgh
Tennessee: Memphis
Texas: Fort Worth, San Antonio
Washington: Seattle
Wisconsin: Milwaukee

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

TECHNICAL REPRINTS: Information derived from NASA activities and initially published in the form of journal articles.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities but not necessarily reporting the results of individual NASA-programmed scientific efforts. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546